

ANATOMICAL PLATES

OF

THE NERVES, &c.

EDITED BY JONES QUAIN, M.D.
AND W. J. E. WILSON.

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October 1st 1848

QUAIN and WILSON
[Anatomical plates. Div. III.]

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Fig. 1.

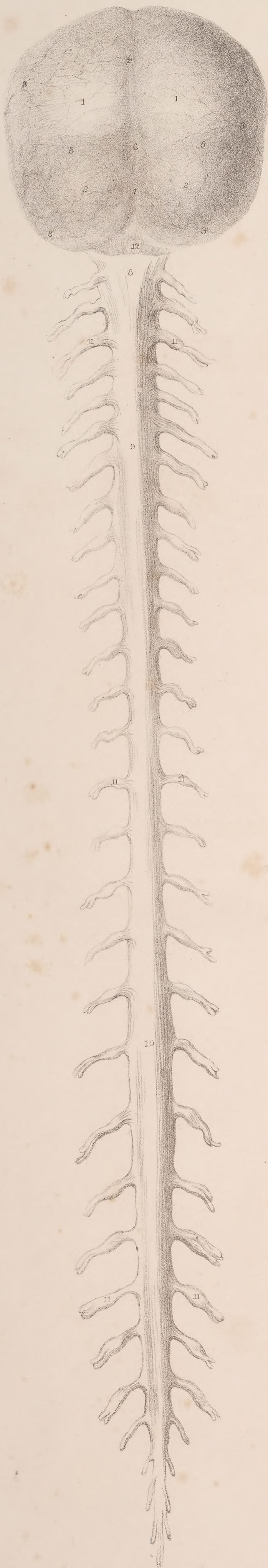


Fig. 2.



F.315

THE
NERVES
OF
THE HUMAN BODY;

INCLUDING
THE BRAIN AND SPINAL MARROW, AND
ORGANS OF SENSE;
IN
A SERIES OF PLATES,
WITH REFERENCES AND PHYSIOLOGICAL COMMENTS.

EDITED BY JONES QUAIN, M.D.

AND
WILLIAM J. E. WILSON.

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REVIEWS

THE HUMAN BODY

A SERIES OF PLATES

WITH ANATOMICAL AND PHYSIOLOGICAL COMMENTARY



LONDON:
PRINTED BY SAMUEL BENTLEY,
Dorset Street, Fleet Street.

ADVERTISEMENT.

THIS Publication consists of a Series of Anatomical Drawings, some original, others selected from monograph treatises or from systematic works. The highest place in the former class is deservedly conceded to the works of Scarpa and Tiedemann, and in the latter, to those of Mascagni and Caldani; but from their size and the style in which they are executed, the expense of publication is necessarily such as to confine their usefulness to comparatively few persons. It may, however, be fairly admitted, that the collections of Cloquet and Loder, though not of equal pretension, are no less valuable to students, as a guide to the knowledge of that complex fabric whose composition they seek to investigate; and to those of maturer age, as a means of reviving impressions received during their earlier studies. As, however, even the works last named, from their price, are inaccessible to some, and to others, from the descriptions and references being given in a foreign language, the want of a similar publication in an English garb has been for some time complained of.

To supply the want here noticed, and at a moderate price, is the object of the present undertaking. The Plates are accompanied by letter-press, containing detailed references to the various objects delineated, the names being set down in English, Latin, and French. But with a view to render them intelligible to a greater number of persons, a running comment on each Plate is given, stating in general terms the uses and purposes which the different objects serve in the animal economy. The drawings are taken on stone by Mr. W. Fairland, from drawings by Mr. J. Walsh and Mr. W. Bagg, and the printing executed by Hullmandel, Graff and Soret, and Fairland.

The Work consists of FIVE DIVISIONS, as follows:

FIRST.—The Muscles.

SECOND.—The Heart and Blood Vessels (Arteries and Veins), with the Lymphatic and Lacteal Vessels.

THIRD.—The Brain and Spinal Marrow; the Nerves and Organs of Sense.

FOURTH.—The Organs of Digestion, Respiration, and Secretion.

FIFTH.—The Bones and Ligaments.

As the order in which the Divisions may appear is of secondary consequence, those are taken first which are most wanted by Students, and which are most interesting in themselves. The number of Plates will be about two hundred and fifty.

NERVOUS SYSTEM.

IN the present division we commence the description of the nervous system. No part of the living economy of man and of animals has occupied more the attention of anatomists and physiologists of all countries, particularly within the present century. The nervous structure exists in various degrees of developement in all the great divisions of the animal kingdom, and is recognisable in almost every class,—its conformation presenting a well-marked series of phases as we trace it from above downwards in the series. It is frequently said that as there are multitudes of animals in which no trace of nervous matter has hitherto been demonstrated, we are not warranted in inferring its existence; yet when we observe groups of these in a drop of water under the microscope, and see them make determinate efforts in eluding one another, in seizing their prey,—when we note their various movements so like in order and method those of animals higher in the scale, and with which we are better acquainted, we cannot hesitate to admit that they are susceptible of external impressions; that is, are the subjects of sensation, and that they are capable of originating distinct acts of volition. We cannot expect to find nervous filaments in the soft gelatinous matter of which the poriferous animals consist. “Their nervous globules (observes Dr. Grant in his Lectures) are diffused through every part of the homogeneous cellular tissue of the body, which possesses the same properties in every part, and is infinitely divisible without destroying its vitality. Their ciliated gemmules, however, are endowed with remarkable living properties and powers of spontaneous motion. They have an obvious object in their motions; they can accelerate, retard, or cease at pleasure the vibrations of their cilia; they can change the direction of their course in the water, perceive each other’s vicinity, revolve round each other, distinguish the most suitable place for the fixing of each species, or bound forward from a state of rest; yet these gemmules contain no visible fibre.”

PLATE I.

The brain and spinal cord, or cerebro-spinal axis.

Fig. 1. The posterior aspect of the brain and spinal cord invested by the dura mater.

Nos. 1, 1. Convexities of the dura mater caused by the projection of the posterior lobes of the cerebrum. 2, 2. Convexities formed by the lobes of the cerebellum. 3, 3. Meningeal arteries supplying the dura mater. 4. A depressed line formed by the collapse of the superior longitudinal sinus. 5, 5. Other lines marking the course of the lateral sinuses. 6. The situation of the torcular Herophili, or conflux of the sinuses. 7. The course of the occipital sinus. 8. The superior swelling of the spinal cord, formed by the medulla oblongata. 9. The middle swelling, corresponding with the origin of the nerves forming the brachial plexus. 10. The inferior swelling, from which the lumbar nerves arise. 11, 11. The spinal nerves, surrounded by a sheath of dura mater; the swelling caused by the ganglion on the posterior root is distinctly marked. 12. A rough surface by which the dura mater is connected to the margin of the occipital foramen and atlas.

Fig. 2. The dura mater has been removed from the brain, and is spread open along the spinal cord, so as to display the pia mater, covered by the thin and transparent arachnoid membrane.

Nos. 1, 1. The convolutions of the two hemispheres of the cerebrum covered by their vascular membrane, the pia mater. 2. The median fissure between the hemispheres, which receives the falx major. 3, 3. The lateral lobes of the cerebellum, also invested with pia mater. 4. The superior vermiform process of the cerebellum. 5, 5. The fissure separating the posterior lobes of the cerebrum from the cerebellum, which lodges the tentorium cerebelli. 6. The depression between the two lobes of the cerebellum, lodging the falx minor. 7, 7. The dura mater of the spinal cord laid open: it is entirely removed below. 8, 8. The membrana dentata, or ligamentum denticulatum, connecting the sides of the spinal cord to the inner surface of the dura mater. 9. The superior swelling of the spinal cord. 10. The middle, or brachial swelling. 11. The inferior, or lumbar swelling. 12. The cauda equina. 13. The posterior longitudinal fissure. 14, 14. The posterior roots of the spinal nerves.

a, a. The eight cervical nerves. b, b. The twelve dorsal nerves. c, c. The five lumbar nerves. d, d. The five sacral nerves. e. The two coccygeal nerves.

NERVES.

B

The nervous system (*système nerveux*), nervous tissue (*tissu nerveux*), *nervus*, *νεῦρον*, may, with great propriety, be said to preside over all the leading functions of the economy; for it would be restricting its influence to a very narrow limit, were we to say that it merely receives impressions from without, and transmits volitions from within: its dominion extends much further. When we see a limb deprived of sensation and motion by an apoplectic seizure, we at once admit that these powers are dependent on nervous action; and we cannot but infer that nutrition and animal heat are equally so, when, at a subsequent period, we find it wasted and reduced in temperature. All persons are aware how the secretions may become deranged and vitiated by injuries of the spinal cord: that of the kidneys, for instance, becomes small in quantity, turbid, and ammoniacal; digestion is suspended by the section of the vagus nerves; and the researches of Le Gallois and Wilson Philip have shown how the circulation is affected by and through the nervous influence. Finally, intellect and reason are instantaneously extinguished if a small fragment of bone be depressed upon the surface of the brain.

Nervous system—general idea of.—Many persons evince a disposition to compare and contrast objects, rather than formally describe them, perhaps with a view of conveying some general notion of their composition and characters. The nervous system has been dealt with in this way, having been likened to a tree; the brain serving as the root, the spinal cord the trunk, and the nerves as branches: but latterly it has been viewed in a different way; the nerves being considered the roots, as they are known to be formed first, and may, as in acephalous cases, exist, although the central masses are never formed; and lastly, it has been compared to a vast net-work of nerves, interlacing by their ultimate filaments at their peripheral terminations throughout the system, and also becoming united by decussation, or by commissures in the central masses. However vague, and in some respects questionable, such loose generalities as these may be, they serve the purpose of conveying to the mind the idea that the nervous system, though complex and subdivided, forms one whole, all its parts being intimately connected and associated, at the same time that some are placed in subordination to others.

Nervous system, symmetrical.—When viewed as a whole, the nervous system is symmetrical in the strictest sense. It consists of two lateral halves, which, being disposed similarly on each side of the central line, resemble one another in every particular. Thus, the brain is divided into two hemispheres, each presenting on its inferior surface three lobes; the cerebellum also is divided into two lobes; and the medulla oblongata into two lateral halves, each consisting of three fasciculi, or bundles of fibres, the division being established by two grooves or sulci, one on its anterior, the other on its posterior aspect, situated exactly in the median line. These sulci, by being continued along the whole length of the medulla spinalis, divide it also into two symmetrical portions. This symmetrical arrangement extends to the nerves, so long as they retain the form of distinct cords; but when, at their peripheral termination, they become expanded into, and blended with, the minute texture of the different organs which they supply, their mode of distribution eludes our research. We can, however, infer that their filaments interlace one with another, so as to form a net-work, by which a complete and free communication is established between them.

Commissures.—Again, when we examine the central parts, we find that each lateral half is connected with the other by certain transverse bands, disposed along the middle line, and which are termed commissures. On this union and connexion between the different parts of the nervous system, by which they become intimately blended at their periphery, as well as towards the centre, the individuality of the animal essentially depends.

The central parts of the nervous system are deeply seated, being enclosed within the spinal canal and the cavity of the cranium. The nervous cords, too, are in a great degree withdrawn from the influence of external agencies by the situations in which they are placed during their course. Their final terminations only approach the surface, where, by being expanded on the internal and external teguments, they communicate to these parts their sentient and tactile properties.

Composition.—The nervous system is made up of two substances, readily distinguishable by their colour, texture, and consistence. One is greyish, or rather a pale ash colour, and hence named *cineritious* (*substantia cinerea*); and as in the brain it forms an investment for the white substance, it is usually termed *cortical* (*s. corticalis*). The other substance is of a pure white colour, and from the relation just indicated is called *medullary* (*substantia medullaris*). It cannot, however, be said with propriety that the one is external, or the other internal, as their position is reversed in different parts of the system. The grey substance invests the cerebral hemispheres, and forms at the same time several masses disposed in their interior; but in the medulla spinalis it is altogether deeply seated.

The white substance, on the contrary, is enclosed by the grey in the brain, but becomes the cortex in the medulla. The cineritious substance is more soft and vascular than the other, and when minutely injected appears as if entirely composed of vessels. Though the white substance in the natural state is not much firmer than jelly, it acquires a great degree of firmness by maceration in spirit, and presents at all times a distinctly fibrous appearance. When these two sorts of nervous matter are attentively examined, they will be found to consist of a peculiar substance called *neurine*, deposited in the areolæ, of a delicate cellular tissue. This anatomical element, in its natural condition, is soft and semi-fluid, and wherever it predominates much, the part will be pulpy and almost diffuent, whilst other portions of the structure are comparatively firm, by reason of the greater quantity of cellular tissue which they contain. The colour of neurine presents some varieties, being white, grey, or yellowish, and in some places of a dusky hue.

When a thin layer of nervous substance is examined with a microscope, it presents the appearance of small granules, placed in lines more or less regularly; but their form and size are liable to vary. These have been taken by some observers for globules, and have formed the basis of many speculations concerning the nature of nervous action: but they resemble much more nearly the delicate flakes observed in coagulated albumen. According to the analysis of Vauquelin, neurine consists of

Water	80.00 parts.
Albumen	7.00
White fatty matter	4.53
Red fatty matter	0.70
Osmazome	1.12
Phosphorus	1.50
Sulphur	5.15

Nerves.—The nerves or nervous cords which issue from the central mass consist of a cylinder of neurine, of a perfectly white colour, enclosed in a thin firm sheath of condensed cellular tissue, called neurilema (*νευρον*, a nerve; *λεμμα*, a husk or rind). But the cords thus formed are not simple in their structure, for each may be divided into a number of smaller filaments, possessed of the same component parts as the nerve itself. According to the researches of Prevost and Dumas, one of these minor subdivisions is itself an aggregate of four delicate fibres, placed pair and pair—two external and two internal, the former being more easily recognised than the latter; and, in all, they observe a number of globules placed in regular lines, thus identifying their composition with that of the brain: but this does not accord with the researches of other physiologists.

The modes of dividing and arranging the parts of this complex structure, suggested by different writers, appear to have been adopted in the first instance in conformity with the opinions which they entertained of its functions and properties. According to Galen, the brain should be considered as the central or fundamental part; Bartholin assigned that rank to the spinal cord. Most anatomists, in times past, divided the system into two parts, viz. the brain and spinal cord, or the central mass (*axe cerebro-spinal*), and the nerves as prolongations from it. Bichât, guided by his peculiar views of the vital phenomena, contended for the existence of two sorts of nervous influence; one being derived from the apparatus appropriated to animal life, viz. the spinal cord, brain, and cerebellum, and the nerves which are connected with them; the other, from the two knotted cords which lie along the spine, which he called the nerves of organic or vegetative life, but which are generally known as the sympathetic or trisplanchnic nerves. Dr. Gall extends the principle of subdivision much farther than his predecessors had done; his previous inquiry into the nature and manifestations of the mental faculties having led him to observe their different modifications in various tribes of animals, as well as in individuals of the same species, and conceiving them to be so many distinct powers, which necessarily require distinct material instruments,—he concluded that each, when in action, works by a distinct portion of cerebral substance, which may be considered as its seat and its organ. In this view of the subject, the nervous system appears to be divisible into as many parts as there are functions to be performed, and faculties to be exercised, each part constituting a special apparatus or organ, as follows:—1. the spinal cord and the double-rooted nerves connected with it, forming the apparatus of sensation and voluntary motion; 2. the medulla oblongata and its nerves, being the apparatus of the special senses; 3. the cerebral masses (cerebrum and cerebellum), divided into the several organs of instincts, sentiments, moral and intellectual faculties.

Willis arranged the nerves under three heads; those arising from the brain, ten in number on each side; those of the spinal cord, thirty-one pairs; and thirdly, the sympathetic nerves. According to this arrangement, nerves differing materially in structure and in function are grouped

together, and some which are totally distinct in every particular, are set down as parts of one whole. The seventh pair of nerves, for instance, consists of a hard and a soft part (*portio dura*, *portio mollis*); and the eighth consists of three parts, the *nervus vagus*, *glosso-pharyngeal*, and *spinal accessory*. Sœmmering has in some measure lessened the confusion arising from this mode of arrangement, by separating the facial nerve from the auditory, and detaching the *glosso-pharyngeal* and the *accessory* from the *vagus*; but the classification still includes a consideration of their position only, without making any reference to structure or function. An arrangement of the nervous system, perfectly free from objection, cannot be expected in the present state of our knowledge; for that pre-supposes a perfect acquaintance with its structure and conformation in all classes of animals, from the highest to the lowest,—of its developement, as tending to show the subordination and dependence of its parts,—and of the functions which each of them performs. The division of the nerves into cerebral and spinal cannot be adhered to any longer; for the fifth,* so called, cerebral nerve is strikingly contrasted in its structure and function with those around it, and with which it has hitherto been classed, whilst it is in every respect similar to those attached to the spinal cord. Neither ought we to continue, as heretofore, to enumerate the nerves in the order of their position from before backwards along the basis of the brain; for the first cerebral nerve (*olfactory*) has no similarity in character or in function with the third (*motor*), nor is the second (*optic*) more closely allied to the sixth (*abductor*), or the seventh (*auditory*) to the ninth (*lingual*). The nerves of the special senses form a distinct group. The following arrangement of the different parts of the nervous system will suffice for our present purposes, and will be found to conform to the views of the best informed physiologists:—

Nervous system of animal life, or life of external relation (Bichât).	Cerebro-spinal axis, composed of	1. The spinal cord, with its cranial prolongation (<i>medulla oblongata</i>), which probably should not be restricted to the lower margin of the pons, but be considered as extending up to where the <i>crura cerebri</i> become identified with the hemispheres, thus including the <i>tractus motorius</i>. 2. Cerebral masses (<i>cerebrum</i> and <i>cerebellum</i>).
	Nerves, or chordæ internunciae grouped into sets, according to their structure and functions.	1. The spinal nerves, symmetrical, with double roots, a ganglion on the posterior one, thirty-two pairs, including the tri-facial or cranial double-rooted nerve. 2. "Superadded" nerves, attached each by a single root to the side of the cord (its upper part), and distributed to the respiratory organs, according to the views of Sir Charles Bell. 3. Simple motor nerves, attached by single roots to the cranial prolongation of the anterior fasciculi of the spinal cord (<i>tractus motorius</i>), 9th, 6th, 3rd. 4. Nerves of special senses, viz. smell, sight, hearing: taste and touch appear to be but modifications of the common tactile property.
Nervous system of organic, or vegetative life; the life of nutrition (Bichât).	The tri-splanchnic nervous system, whose ramifications extend through all the viscera (<i>σπλαγχνία</i>), called by some gangliac (though ganglia are not peculiar to it), also sympathetic. We may, with De Blainville,† consider it as divisible into two parts: one placed in front of the spine (<i>præ-vertebral</i>), composed of plexus and ganglia (<i>semi-lunar</i> and <i>cardiac</i>), whose branches are distributed to the primary organs of digestion and circulation; the other, consisting of two knotted cords, extended along the whole length of the spine, communicating with the <i>præ-vertebral</i> plexus on the one hand, and with the cerebro-spinal nerves on the other.	

We shall describe and illustrate the different parts of the nervous system in the following order (having first treated of the membranes which invest them):—1. The spinal cord; 2. The brain; 3.

* Sir C. Bell on the Nervous System.

† Cours d'Anatomie et de Physiologie Comparée.

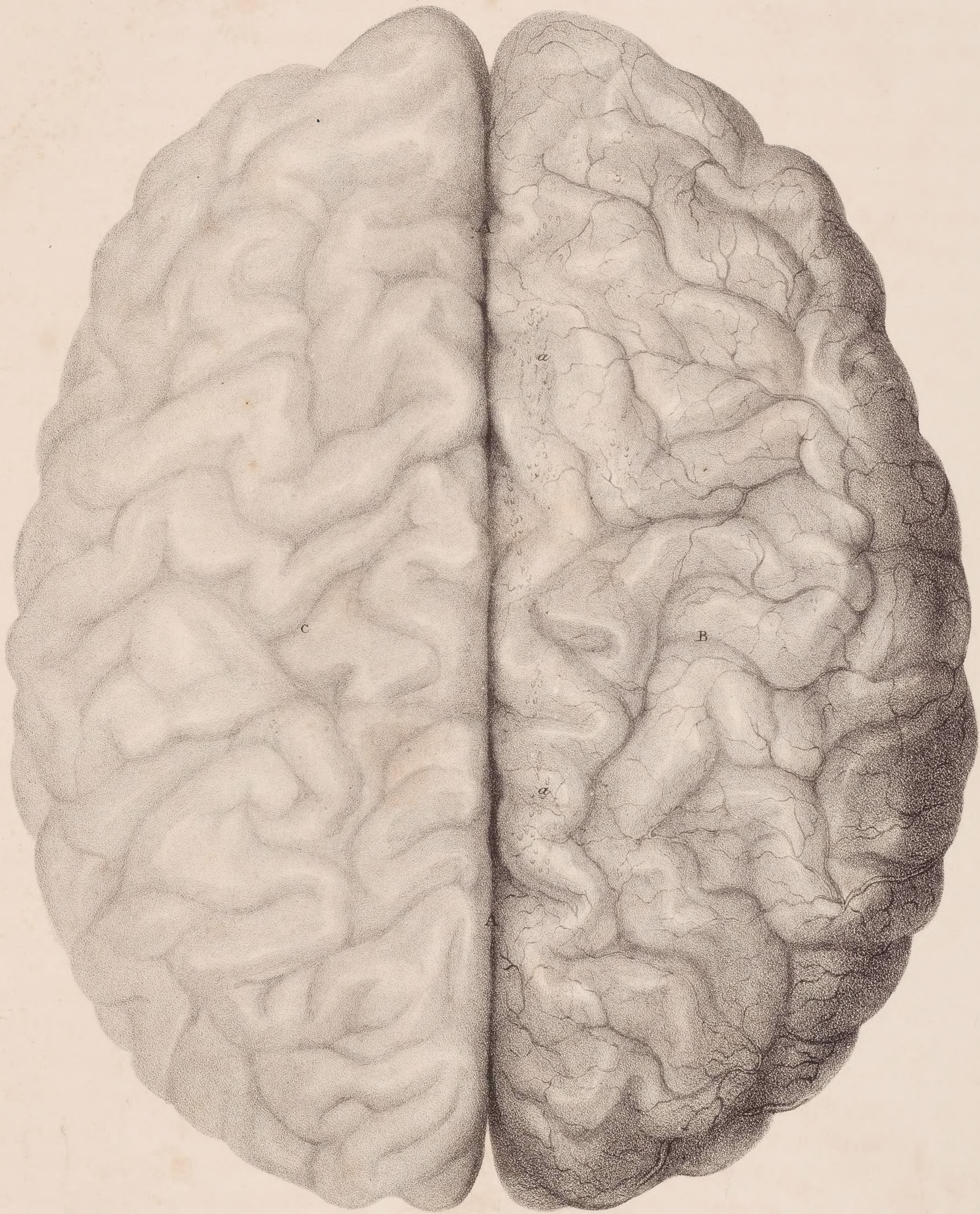
PLATE II.

The brain removed from the cranium, displaying its upper surface. The pia mater on the right side is retained; on the left side it has been removed to show the form and arrangement of the convolutions.

A, A. The median fissure dividing the two cerebral hemispheres. Before the removal of the dura mater it is occupied by the falx. B. The right hemisphere invested by its pia mater. C. The left hemisphere, marked by the furrows which divide the convolutions.

a, a. The small granular bodies, which are termed *glandulæ Pacchioni*.

Plate 2.



W. J. E. Wilson direxit

Drawn from Nature by W. Bagg

W. Fairland lith.

London Taylor & Walton Upper Gower St.

Printed by Fairland

Plate 3.



W. J. E. Wilson delin.

Drawn from Nature by W. Bagg

W. Fairland lithog.

London T. Taylor & Walton Upper Gower St.

Printed by Fairland

The cerebral nerves, properly so called, viz. olfactory, optic, auditory; 4. The single-rooted motor nerves, viz. the third, sixth, ninth, and fourth; 5. The respiratory set of nerves, facial (portio dura), glosso-pharyngeal, nervus vagus, and accessorius; 6. The spinal nerves with two roots; and, 7. The sympathetic nervous system.

MEMBRANES OF THE BRAIN AND SPINAL CORD.

The brain and the spinal cord are invested by three membranous lamellæ, namely, the dura mater, the arachnoid membrane, and the pia mater.

Dura mater.—The dura mater (plate I. fig. 1; $\mu\eta\eta\iota\gamma\zeta\ \sigma\chi\lambda\eta\rho\eta$), which is the most external of the three, is thick, firm, and resisting, and belongs to the class of fibrous, or rather fibro-serous membranes, as it is in reality a compound structure; the outer lamella being fibrous, the inner serous and derived from the arachnoid membrane. It is in close apposition with the cranium, which it lines, at the same time that it invests the brain, and sends inwards processes, which are interposed between its different parts, serving to sustain them. It is, moreover, prolonged in a tubular form through the spinal canal, but is separated from the bones by a lamella of adipose tissue and the great spinal veins. It adheres closely to the arch of the skull, particularly along the sutures, but at its base the points of connexion are multiplied by its passing over the inequalities of the surface, and still more so by sending tubular prolongations through the different foramina, serving to enclose and protect the nerves which they transmit. Along the spinal column similar prolongations pass out with the nerves through the intervertebral foramina: these constitute its chief connexion with the bones. But towards the lower part of the sacral canal it is fixed by some irregular fibrous bands.

The processes formed by the dura mater are the following:—

The *falx cerebri* is lodged in the longitudinal fissure between the hemispheres of the brain, forming a partition between them. It is narrow before, broad behind, and presents a curved border inferiorly, so that in shape it resembles a sickle: hence its name. It extends from the crista galli of the ethmoid bone, which is inserted between its lamellæ, to the internal occipital protuberance, on a level with which it branches out at each side, becoming blended with the tentorium cerebelli. It seems as if formed in the following manner:—The fibres of the dura mater, on approaching the sagittal suture from each side, divide into two lamellæ, one of which is continued uninterruptedly across, thereby maintaining the continuity of the membrane; but the other dips down, converging to that of the opposite side, by which means they enclose between them an angular interval, viz. the longitudinal sinus. After their union they continue to descend to the margin of the falx, where they separate, and unite again, so as to form the inferior longitudinal sinus. A section of the upper sinus is found to be triangular, of the lower circular. On the surface of the dura mater, in the sinus, or upon the cerebral hemispheres, small albuminous masses occasionally exist, called glandulæ Pacchioni, apparently resulting from morbid action.

The *tentorium cerebelli* spreads out from the base of the falx, and serves to support the posterior lobes of the brain; one border of it is attached all around to the lateral grooves on the occipital bone, and to the margin of the pars petrosa; the other, concave and free, encloses an oval interval, which transmits the crura cerebri, processus ad testes, and basilar artery.

The *falx cerebelli* is a narrow fold placed between the lobes of the cerebellum, extending vertically from the under surface of the tentorium to the foramen magnum; its base lodges the occipital sinuses.

Pia mater.—The pia mater (plate II. B, $\mu\eta\eta\iota\gamma\zeta\ \lambda\epsilon\pi\tau\eta$) in its anatomical characters differs considerably from the other membranes. It is made up of a thin lamella of cellular tissue, permeated by a multitude of minute capillary arteries, which ramify in it previously to their entrance into the cerebral substance. It invests the medulla spinalis, as well as the brain, and dips into the sulci

PLATE III.

This view of the brain is named the centrum ovale majus: it is made by slicing off the hemispheres of the cerebrum to a level with the corpus callosum.

A, A. The corpus callosum, or great commissure of the hemispheres, marked by transverse lines (lineæ transversæ). B. The raphé, extending along the middle line of the corpus callosum. C, C. The white, or medullary substance of the brain, marked by numerous red points, produced by the division of small arteries. D, D. The grey, or cortical substance of the brain, surrounding the white substance, and passing deeply to the bottom of the sulci, E, E, which are of very unequal extent. F. The posterior border of the cerebellum.

NERVES.

C

between the convolutions of the latter: we also find it enclosed within the ventricles, where it is named "plexus choroides" (*χορσιον, ειδος*). Its inner surface is in close contact with the cerebral substance; the external is in apposition with the arachnoid membrane on the surface of the convolutions, but loses all connexion with it after passing into the sulci.

Plexus choroides.—(Plates IV. P, and V.).—In the fissure observable at the base of the brain, between the inner margin of its middle lobe and the crus cerebri, the pia mater, which invests the external surface, is continuous with that process of it (plexus choroides) which is found in the ventricles; so that, when we trace it, we find it, as it were, entering at the inferior cornu of the ventricle, where it corresponds at first with the interstice between the corpus fimbriatum and the crus cerebri, and afterwards lies along the floor of the ventricle, in which it ascends upon the thalamus nervi optici, and unites at the foramen or fissure of Monro with the plexus of the other side. At its entrance into the ventricle the plexus is drawn together so as to resemble a small vascular bundle, and becomes invested by the arachnoid membrane, which, by its reflection from the sides of the ventricles to the plexus, maintains the integrity of the cavity.

Where the pia mater is prolonged on the medulla oblongata, it forms a small plexus, which enters into the fourth ventricle, and becomes also invested by a duplicature of the arachnoid. As the membrane descends into the spinal canal, it becomes firm, resistant, and much paler in colour. Its inner surface is in close contact with the cord, the exterior is but slightly connected with the arachnoid; but the nerves, at the different points at which they pass outwards, derive from it their immediate investment, or neurilema. The difference of character here pointed out between the spinal and cerebral parts of the pia mater, appears to MM. Jules and Hippolite Cloquet sufficient to induce them to consider it as a distinct structure. But it would be difficult to show where the continuity of the membrane is interrupted; and as to any difference of character and consistence that may appear, they are merely such as may be supposed to arise from the different circumstances in which the membrane is placed. In the spine it is exposed, at least in some degree, to the influence of motion and pressure, which necessarily produce the same effect on it as on cellular textures elsewhere; that is to say, they render it thick and lamellar. Again, in the skull it is in contact with gray substance, in the spine with white; so that we can readily account for the difference of the vascularity in the membrane, by recurring to the relative vascularity of the structures with which it is in contact.

Arachnoid membrane.—The serous investment of the brain and spinal cord is called the *arachnoid membrane*, from its tenuity (*αραχνη*, a spider's web; *ειδος*). It is smooth and transparent, and, like all the other membranes to which it belongs, forms a shut sac: one part of it invests the cord and the brain, passing over its surface without dipping into the convolutions; the other lines the dura mater, and its different processes, with which it is inseparably connected. Moreover, as the nerves and vessels pass across the intervals between their points of attachment to the cerebral substance, and those by which they escape from the cavity of the cranium, they are enclosed in tubular prolongations of the arachnoid membrane, which are continuous by one extremity with the portion investing the brain and the cord, and by the other with that which lines the dura mater. By this arrangement the continuity of the membrane is maintained, at the same time that the apertures of transmission are closed. The arachnoid membrane is prolonged into the ventricles, lining them in their entire extent, and forming within them a remarkable duplicature (plate V, *velum interpositum*). By these means its arrangement is rendered as complex as that of the peritonæum; and were we, with the same view, and on the same principle, to "trace its reflections," they would be found as follow:

We shall suppose, in the first place, a vertical section of the skull and the spine to be made, so as to lay open their cavities. Commencing then at the vertex, we trace the membrane along the upper and under surface of the anterior lobe of the brain, and thence downwards upon the crus cerebri and pons. We then follow it on the anterior surface of the medulla spinalis down to the extremity of the cauda equina, where it is reflected upon the different nerves which guide it to the contiguous surface of the dura mater, with which it becomes in a manner identified, forming a lining for it as far as the foramen magnum. From the foramen the membrane continues its adhesion to the dura mater, forwards upon the base of the skull, then up along its roof, and thence backwards to the occipital protuberance. At the latter point it is reflected over the tentorium, coating both its surfaces, and is thence prolonged down through the foramen magnum, still bearing the same relation to the fibrous membrane, as far as the extremity of the canal. At this point it is reflected forwards upon the medulla, which it invests in its entire extent. From the medulla oblongata it is, as it were, guided by the corpora restiformia to the cerebellum, and, having invested both its surfaces, reaches the

processus ad testes, on which it is continued to the under surface of the cerebral hemisphere, and is thence prolonged to the vertex, that is to say, to the point from which we set out.

When the continuity of surface is thus shown at each side, the lateral parts of the membrane will be found continuous, by tracing them over the flat surfaces of the hemispheres, and down to the corpus callosum; so that if a transverse section were made of the cerebral hemispheres, the part of the membrane which is reflected from their flat surfaces over the corpus callosum will represent a cul-de-sac.

But it will be asked, how and where can the external or investing part be shown to be continuous with that which lines the ventricles? The fact can be demonstrated as follows:—If we trace the membrane along the posterior border of the corpus callosum, it will be found to turn beneath it, and to enter the ventricle through the fissure of Bichât. Again, the part of it which lies on the tubercula quadrigemina is also prolonged into the ventricles, lying, like the preceding, close on the cerebral substance, and constituting an investment for it. If the falx and tentorium have been left undisturbed, a tubular process of arachnoid membrane will be observed (by drawing aside the posterior cerebral lobes) passing out of the fissure, and directed backwards to the point at which the border of the falx joins with that of the tentorium. This process is prolonged from the velum interpositum, and encloses the venæ Galeni, which are two small veins that return the blood from the plexus choroides, and pass from before backwards, enclosed within the velum, to terminate in the straight sinus. We have then within the ventricles to examine a prolongation of the membrane which lines their surface, and another, which is in a manner free and unattached (*velum interpositum*), each being continuous with the other, and both with the more extended serous surface already examined. That the membrane lines the roof of the ventricles, may be proved by cautiously dividing the fibres of the corpus callosum, and pushing them aside. A thin membranous lamella will be thus exposed, which, though diaphanous, is sufficiently firm to confine air or fluid passed into the ventricle. There are then two entering layers, one along the roof, the other on the floor of the ventricle, and a returning or tubular process continued back from these, and terminating as above stated. Their arrangement appears to be as follows:—the arachnoid membrane, after investing the surface of the corpus callosum as far as its posterior border, turns beneath it, passing through the foramen of Bichât. After lining the under surface of the fornix, it is reflected over its borders to the septum lucidum, upon which it is prolonged to the roof of the ventricles, and so to their outer margins. In this way it may be traced into the posterior and descending cornua as far as the points at which the plexus choroides of each side enters, on the upper surface of which it is reflected, to form the commencement of the velum interpositum. Now the part of the membrane that covers the tubercula quadrigemina, on reaching the interior of the ventricle, sends in the middle line a process into the third ventricle, which is prolonged in the form of a cul-de-sac downwards into the fourth ventricle, lining its walls and closing its cavity inferiorly. On each side the membrane extends along the floor of the ventricles to their outer margins, where it is continuous with the part already traced to these points. It is similarly disposed of in the floor of the posterior and descending cornua; and on reaching the fissures which admit the plexus choroides at each side, it is reflected on the under surface of the latter, the part that lined the roof having been reflected on their upper surface; so that they are enclosed between two lamellæ of the serous membrane, in their entire extent, from the lateral fissures to the foramen Monroi. These lamellæ, from being stretched from side to side, between the fornix and the third ventricle, constitute what is called *velum interpositum*: posteriorly, the velum is narrowed to a funnel-shaped process, which makes its exit through the fissure of Bichât, and, on reaching the point at which the falx spreads into the tentorium, becomes continuous with the part of the membrane which lines these processes.

Membrana dentata (plate I. fig. 2, 8, 8; ligamentum denticulatum, vel serratum).—At each side of the spinal cord, along its whole length, is placed a shining, thin, but firm membrane, which is attached to the tube of the dura mater by a series of pointed processes, from which circumstance its name is derived. It extends from the border of the foramen magnum, to which its first dentation is attached, down to the first lumbar vertebra, in all which extent it is interposed between the anterior and posterior roots of the nerves, one of its surfaces looking forwards, the other backwards. The external or dentated border being attached (by so many points as there are dentations—about twenty in all) to the dura mater, the place of their attachment is midway, or very nearly so, between the foramina for the exit of the nerves. Its inner border, corresponding in position and direction with the lateral sulcus of the spinal cord, rests against the pia mater, which encloses the cord, and appears

to be connected with it by delicate cellular tissue. Is it a distinct structure? *Adhuc sub judice lis est.*

The spinal cord.—The spinal cord (plate I.; *chorda spinalis*, *medulla spinalis*, *cerebrum oblongatum*) is that part of the cerebro-spinal mass which is enclosed within the spinal canal. The term “medulla,” commonly given to it, cannot with propriety be retained; as it obviously bears no similitude to the “marrow” of long bones; and it certainly is not a prolongation of the brain, which the name *cerebrum oblongatum* would imply, for its appearance and developement precede that of the brain. We must observe, that though, as the name implies, the greater part of the cord is enclosed within the canal, still a portion of it is prolonged into the skull, and rests on the basilar process of the occipital bone. On this is founded its division into *chorda spinalis* and *chorda oblongata* (*medulla oblongata*).

Spinal cord, dissection of.—In order to expose the cord, previously to examining its structure it is necessary to saw through the broad part of the occipital bone down to the foramen magnum, and then to cut through the arches of the vertebræ at each side, along the whole of the column, with a knife, or chisel and mallet, as it is both tedious and troublesome to saw them. The arches being removed, the dura mater may be laid open in its entire length, and the description of the contained parts referred to. Slit open the tube formed by the dura mater, reflect the borders of it to each side, observe the roots of the nerves, the filaments which collect to compose them, and carefully note the *ligamentum dentatum*—its relations to the nerves and to the other membranes.

In the adult human subject, the cord extends from the lower border of the pons Varolii as far as the first or second lumbar vertebra. In the early periods of foetal life it extends throughout the whole length of the spinal canal, conforming in this particular with the permanent condition of it in lower animals, in which it reaches even to the caudal prolongation of the column. As the process of growth and developement goes on, the relation of the cord to its osseous canal varies, so that ultimately it reaches only to the point above stated. Keuffel, however, saw it in one case end opposite the eleventh dorsal vertebra, and in another reach as far as the third lumbar. Its form, considered in its general outline, is cylindrical; but its transverse diameter is somewhat greater than the antero-posterior, which gives it a flattened appearance in the former direction. The size of the cord is not the same from one extremity to the other; neither does it increase or diminish uniformly. Three distinct swellings are observable in different parts of its extent. Superiorly (fig. 1, No. 8; fig. 2, No. 9) it is enlarged where it is in apposition with the margin of the pons Varolii, but gradually diminishes as it approaches the foramen magnum. The second swelling (fig. 1, No. 9; fig. 2, No. 10) corresponds with the interval between the third and sixth cervical vertebræ; the third (fig. 1, No. 10; fig. 2, No. 11) with that between the tenth dorsal and the first lumbar. Its inferior termination is subject to considerable variety in different cases. It usually becomes fusiform, and terminates in a point a few lines below the lumbar swelling: in other instances it ends in a small bulb, slightly constricted at its centre; but any varieties of conformation presented by this portion deserve little attention, as none of the nerves arise from it.

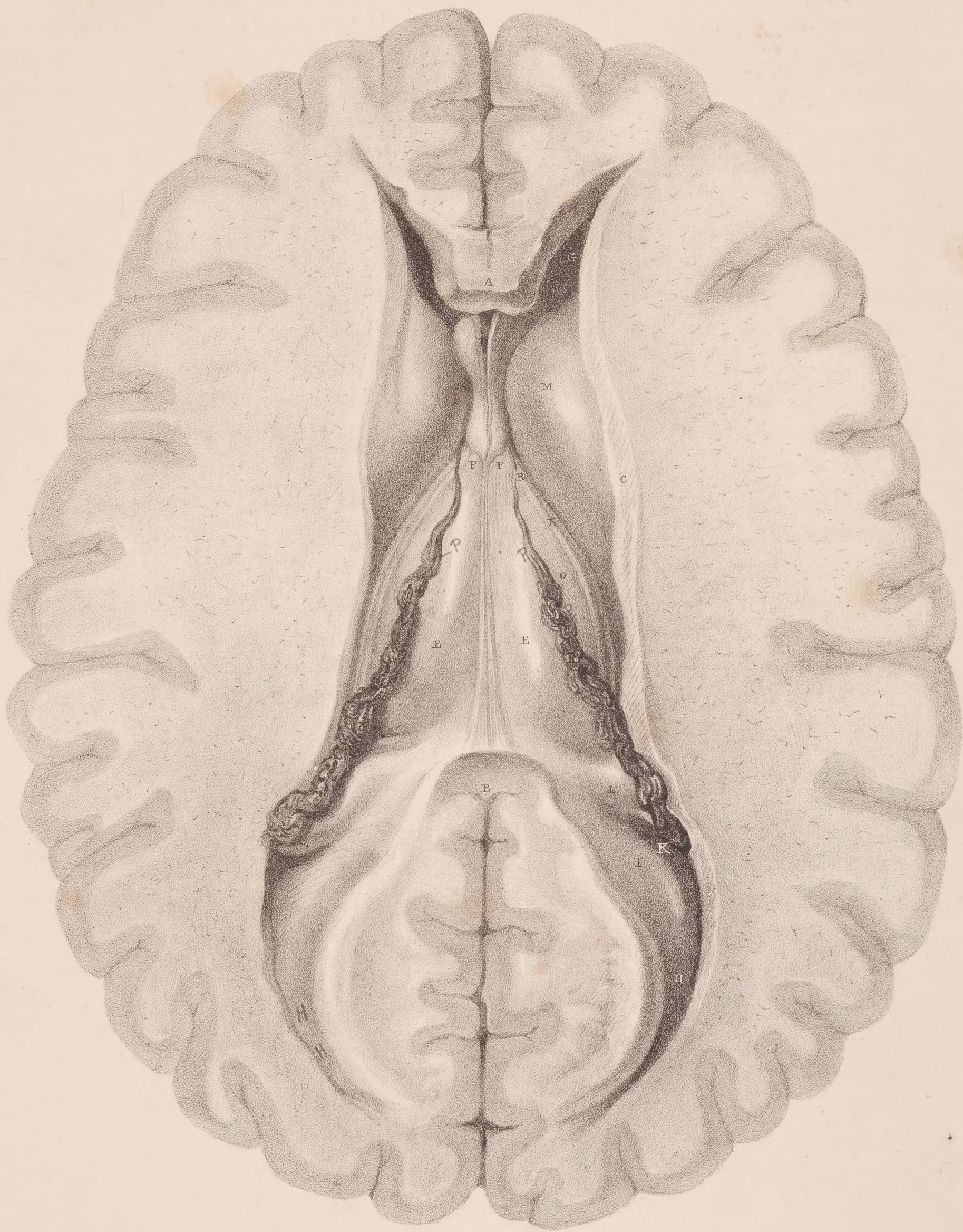
When detached from its connexions, the cord is found to be divided into two lateral halves, by grooves (*sulci*) extending along its whole length, one situated on the anterior, the other on the posterior aspect. The white substance which encircles these two lateral parts or fascies dips into the *sulci*; but it is somewhat remarkable, that, in the anterior one, the fibres are observed to pass from side to side, and intermix along the median line; in the posterior one they all pursue the longitudinal direction. At each side of these grooves, two others (*fissuræ laterales*) may be observed running

PLATE IV.

The lateral ventricles of the brain. These are brought into view by removing the corpus callosum, and dividing the hemispheres in the course of the cornua.

- A. The anterior extremity of the corpus callosum. B. Its posterior extremity continuous with the fornix. C. The edge of the hemisphere, from which the corpus callosum has been divided. D. The two lamellæ of the septum lucidum, the intervening space being the fifth ventricle. E, E. The fornix. F, F. The pillars (*crura*) of the fornix. G. The anterior cornu of the right lateral ventricle. H. Its posterior cornu (digital cavity), containing the hippocampus minor, I. K. The entrance of the inferior or descending cornu. L. The commencement of the hippocampus major. M. The corpus striatum of the right lateral ventricle. N. The *tænia semicircularis*. O. The optic thalamus of the right side. P. The choroid plexus, communicating with that of the opposite side through, R, the foramen of Monro.

Plate 4.



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Plate 5.



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parallel with them, being, however, but faintly marked. These indicate the lines in which the anterior and posterior roots of the spinal nerves are attached to the cord; and, finally, along the lateral aspect of the cord, a slightly depressed line may be traced down as a continuation of that which separates the corpus restiforme from the olivare, gradually, however, becoming more faint, and ceasing to be perceptible about the upper part of the dorsal region.

Spinal nerves.—The spinal cord gives attachment to thirty-one pairs of nerves, which are regular, symmetrical, and double-rooted. One of the roots of each nerve arises from the anterior, the other (plate I. fig. 2, 14, 14) from the posterior aspect of the cord. The fibres which form the latter pass outwards, converging towards one another, and in the tubular investment of dura mater, which encloses them, form a ganglion (fig. 1, 11, 11). The fibres of the anterior root pass to the same point, and, having united, join with the preceding, immediately external to the ganglion. The trunk thus formed is a compound nerve in structure and in function, sensation being transmitted, according to the researches of Sir C. Bell, by the posterior root, and the power of motion by the anterior. There are eight cervical pairs of nerves (fig. 2, a, a), the upper four of which form a plexus at the side of the neck (cervical plexus); the lower four, with the first dorsal, constitute the brachial plexus: the dorsal nerves are twelve in number (fig. 2, b, b): eleven of them correspond with the intercostal spaces. There are five pairs of lumbar nerves (fig. 2, c, c), and six sacral (fig. 2, d, d), which form each a plexus (lumbar and sacral plexus), but which are joined in such a way as to form one elongated interlacement (lumbo-sacral), from which issue the nerves of the lower extremity.

Medulla oblongata.—The cranial portion of the cord (plate VIII. F.; *chorda oblongata, medulla oblongata*) is broad and thick superiorly near the pons Varolii, but tapers gradually towards the occipital foramen. Its anterior aspect is rounded, the posterior is somewhat flattened, and each presents a continuation of the median sulcus (anterior and posterior) by which it is divided into two symmetrical parts. The lateral depressions, which correspond with the points of origin of the spinal nerves, are also continued upwards into the medulla oblongata. But though inferiorly the divisions established by these lines are so slightly marked as to have escaped notice, until Chaussier directed his attention to the subject, yet in the superior part (*medulla oblongata*) they are so well defined as to have been deemed deserving of particular names. The anterior and posterior pair have been called the anterior and posterior pyramids; the middle, from their shape, the corpora olivaria. These, according to Gall, are made up of the primitive or formative fibres of the cerebrum and cerebellum; for if they be traced upwards, the anterior pyramids and the corpora olivaria will be found continuous with the fibres which are expanded into the cerebral hemispheres, whilst the posterior pyramids (usually called, since Ridley's time, *corpora restiformia*) are evolved into the lobes of the cerebellum. Besides these parts, which have been noticed by all anatomists, Sir C. Bell has described another, which is situated between the corpus olivare and restiforme. This consists of a narrow line of white matter, which may be traced along the medulla oblongata, and from thence downwards between the anterior and posterior roots of the spinal nerves. It is but slightly marked in the lower part of its extent, but becomes more perceptible opposite the corpus olivare; after which it narrows, and ceases altogether at the margin of the pons, "not being continued upwards into the cerebral mass." This may be termed *tractus respiratorius*, as it gives origin to the class of respiratory nerves as established by Sir C. Bell.

PLATE V.

In this view of the brain the fornix is removed, and the hemispheres are sliced away nearly to their base, to show the extent of the middle or descending cornu.

- A. The anterior extremity of the corpus callosum. B. The anterior cornu of the lateral ventricle of one side. C. The remains of the septum lucidum and fifth ventricle. D. The anterior pillars of the fornix divided and thrown forwards. E. The corpus striatum of the left ventricle. F. The tenia semicircularis. G. The thalamus opticus. H, H. The velum interpositum, a vascular net-work extending between the choroid plexus. I, I. The choroid plexus. K. The communication between the choroid plexus of each side anteriorly. L. The venæ Galeni terminating posteriorly in, M, the commencement of the straight (fourth) sinus. N, N. The impression of the corpora quadrigemina, seen through the velum interpositum. O, O. The hemispheres of the brain sliced very deeply to display the parts contained in the descending cornu. P. The hippocampus major. Q. The pes hippocampi. R. Part of the corpus fimbriatum. S. The divided extremity of the hippocampus major and corpus fimbriatum. T. The choroid plexus contained within the middle cornu. V. The outline of the posterior cornu. W. The posterior lobes of the cerebrum divided to show the upper surface of the cerebellum invested by pia mater. X. The superior vermiform process of the cerebellum.

Structure.—A transverse section of the medulla shows it to consist of a thin lamella of white matter, enclosing the gray or cineritious substance. The latter is disposed in a very peculiar way (plate VIII. G); it presents two lateral portions, each of a crescentic form, their concavities looking outwards; the convex sides of each are turned towards the middle line, and are connected by a short transverse fasciculus of gray matter. The anterior cornua of the lateral masses are rather thick and rounded; the posterior extend as far as the corresponding collateral sulci.

The *anterior pyramids* (plate VIII. m; corpora pyramidalia) are close together, being separated only by the anterior sulcus, and extend, enclosed between the corpora olivaria, from the margin of the pons Varolii to the foramen magnum. Some of the fibres of each pyramid which are close to the sulcus pass across it obliquely, and so a decussation (n) is produced between them. The rest continue their course uninterruptedly, so that only a part of the pyramids change place, or decussate.

The *olivary bodies* (plate VIII. o; corpora olivaria), when stripped of their medullary lamella, are found to consist each of an oblong mass of gray matter, surrounded by a fringed or scalloped border, and attached towards the middle line by a slight petiole. Owing to this arrangement, it presents, when divided by a transverse section, an arborescent appearance.

The *posterior pyramids* (plate VII. X, X; plate VIII. p; corpora restiformia, pyramides postérieures, Gall) correspond with the posterior and lateral parts of the medulla; they diverge as they ascend towards the lobes of the cerebellum. The posterior aspect of the medulla oblongata is slightly concave, and divided into two lateral parts by the median sulcus, to which two oblique lines converge, giving it an indented appearance. This has been termed *calamus scriptorius* (plate VII. W). One or two elongated cords are also observable on this surface, which have not as yet received names, “but whose offices may one day be discovered.”*

The Brain.—The part of the central mass of the nervous system which is lodged within the skull, has been called from this circumstance “encephalum.” It presents, even on a superficial inspection, a division into parts, which differ in position, size, and form, as well as in the arrangement of their components; these have been named cerebrum, cerebellum (or great and little brain), cerebral protuberance, and lastly, the connecting link between these and the spinal part, viz. the medulla oblongata.

Dissection of the Brain.—When proceeding to open the skull (the muscles having been previously dissected), it will be found convenient to saw through the external table of the bones all round, from the superciliary ridge to the occipital protuberance. When this has been done, the inner table may be broken through by employing a small mallet and chisel, or a strong knife made for the purpose. After the roof of the skull is removed, the chin should be supported on a block, and the dissection proceeded with. An incision may be made along the middle line, so as to lay open the longitudinal sinus, after which the dura mater may be divided by a horizontal incision carried along the whole length of one of the hemispheres, on a level with the section made in the bone. This portion of the membrane may then be drawn to the opposite side, which will expose the surface of the brain, the falx cerebri, the fissure between the hemispheres, &c. All the parts here named should be examined attentively, the descriptions given of them in the different sections being at the same time read.

In the next place, let the hemisphere which is uncovered be drawn aside so as to expose the corpus callosum; after which its substance may be cut through, by passing down a scalpel to a level with the corpus callosum, and then directing its edge outwards and upwards somewhat, so as to avoid entering the ventricle.

To open the Ventricle.—The lateral ventricle may be opened by making an incision through the corpus callosum parallel with its raphé, and everting the external portion of it. The parts within the body and anterior and posterior cornua of the ventricle being examined, the descriptions given of their form, size, and position being read, the descending cornu should in the next place be traced by following the plexus choroides downwards into it: after which it can be fully exposed by making an incision through the substance of the optic thalamus down to the cornu, so as to remove the external two-thirds of it. If the cornu ammonis be drawn outwards, the point at which the plexus enters will distinctly appear, and also the change presented by the pia mater where it enters the ventricle. The greater part of the substance of the hemisphere may now be removed, and the tentorium cerebelli at the same time detached from the pars petrosa, and reflected backwards. This will expose the greater number of the cerebral nerves, and give a side-view of their course and relations within the cranium. Those within the cavernous sinus may be brought into view by following the third, fifth, and sixth through the foramina in the dura mater, and everting it as it is cut up.

* Sir C. Bell's Exposition of the Nervous System, p. 21.

The brain (plate II, *cerebrum*) forms the largest portion of the central mass of the nervous system, and occupies the principal part of the cranial cavity. It extends from the frontal bone to the occipital fossæ, resting on the orbital processes of the former, on the tentorium cerebelli posteriorly, and in the centre descends into the middle fossæ, at the base of the skull. Its superior surface is convex and arched, corresponding with the vault of the cranium, beneath which it is placed, and presents along the middle line a deep fissure (A), running from before backwards, by which it is divided into two equal parts (*hemispheres*). The surface of the brain is rendered unequal by several depressions and elevations marked upon it. The elevations are called *convolutions* (*gyri*), and are situated between the depressions (*sulci*). The course of the convolutions is winding and tortuous, as the name implies, and their size presents many varieties in different places. It should be observed, that the anterior extremity of the brain, which corresponds with the frontal bone, is narrower than the posterior, which is in apposition with the occipital bone.

Hemispheres (plate II. B, C).—The external surface of each hemisphere is convex in its general outline; the internal is flat and compressed, as it rests against its fellow of the opposite side, the falx major being interposed between them. The inferior surface presents several depressions and inequalities, corresponding with those of the base of the skull.

Lobes (plate VIII.)—On the inferior surface of each hemisphere is observed its division into three *lobes*. The anterior lobe (A) rests on the orbital process of the frontal bone and the smaller wing of the sphenoid bone; the posterior (C) is supported by the tentorium cerebelli; and the middle (B) is received into the central fossa, at the base of the skull. The anterior is separated from the middle lobe by a deep fissure (*fissura Sylvii*); but there is no precise line of demarcation between the latter and the posterior.

The *Brain—its external surface*.—The relation of size, form, and situation of the different objects seen on the external surface of the brain, should be carefully noted, as allusions are constantly being made to them during the description of the parts deeply seated, and also when tracing the progress of its development in the human subject, or in the animal series, and particularly when, after the manner of Gall and Spurzheim, we follow the course of the nervous fibres through the successive steps of their expansion, as the phrase is, from the medulla upwards into the cerebral hemispheres. Nothing of consequence remains to be noticed on the superior and external surface, in addition to what has been already stated.

To examine the origins of the nerves and the parts at the base of the brain, it must be detached from its situation and inverted; but it is not necessary to repeat what has been already stated in our description of the exterior of the brain: note first the parts which lie along the median line, beginning with the anterior sulcus, and proceeding with them from before backwards. Note their size and relations, compare them with the descriptions. Then take the objects which are placed more externally. Observe the relative position, form, direction, and size of the different nerves. You will at once recognise the olfactory running forwards, in a manner embedded in a groove in the anterior lobe, about a finger's breadth outside the median sulcus. In the interval between these, at their roots, you recognise the commissure of the optic nerves, behind which is the tuber cinereum and the infundibulum; behind the tuber are the corpora albicantia, and then a small depressed triangular space, the locus perforatus, on each side of which is the crus cerebri. Attached to the crus, towards its inner side, is the third nerve, and upon its outer side rests the inner convolution of the middle lobe; evert the latter, and you see the fissure through which the pia mater enters the inferior cornu of the lateral ventricle. Whilst doing this, you recognise the optic nerve, rather soft and flat, resting on the crus cerebri, and curving forwards to its commissure.

Now, returning again to the middle line, you find behind the crura, and as if overlapping them at their commencement, the broad white lamella—pons Varolii; trace its fibres outwards, and you observe them to be continuous with the crus cerebelli at each side, which is concealed by some minor lobules. And here, at the junction of the pons with the crus, you see the fifth nerve. At the posterior border of the pons is the medulla oblongata, presenting the two pyramids close together, one at each side of the middle line; external to these are the olivary bodies, and still farther out the restiform. At the junction of the pyramid with the pons is the sixth nerve. Along the groove, between the pyramid and the olivare, are several delicate filaments, forming the origin of the ninth or lingual nerve. A little farther out you see a small nerve running parallel with the medulla, as it were, coming up from the foramen magnum—this is the nervus accessorius. Now look at the groove between the olivary and restiform bodies, and you will find in the first place, high up and close to the pons, the portio dura, a rounded small cord; immediately beneath it a very small nerve—the glosso-

pharyngeal, to which succeeds a flat fasciculus, the nervus vagus. Evert the medulla a little, or draw it forwards—you see the calamus scriptorius—a groove and fissure like the point of a writing-pen; higher up, a few oblique lines faintly traced upon the surface, and then the portio mollis, or auditory nerve. Finally, draw the lobes of the cerebellum forward so as to invert it, you see a white lamella in front of it—the valve of Vieussens, and the fourth nerve attached to it.

The Brain—its base or inferior surface (plate VIII.)—When we turn to the inferior surface, we observe that it presents in the middle line, and in front, a fissure (a), being the continuation of the longitudinal one, which establishes the separation between the hemispheres. It lodges the anterior extremity of the falx cerebri, its depth being limited by the corpus callosum, which passes across from one hemisphere to the other. The inferior surface of each anterior lobe, as it corresponds with the orbital plate on which it rests, is slightly concave.

Sulcus olfactorius.—A few lines external to the longitudinal fissure, and parallel with it, is a groove, resembling one of the sulci, which lodges the olfactory nerve (1), and at its posterior extremity is a rounded papilla, from which one root of that nerve is derived.

Fissure of Sylvius (b).—Posterior to the groove just noticed is the fissure (fissura Sylvii) which marks the separation between the anterior and middle lobes, and lodges the middle artery of the brain. It inclines from within outwards and upwards, and gradually terminates amongst the convolutions on the exterior of the hemisphere, its direction corresponding with that of the small wing of the sphenoid bone. At its internal termination it forms a right angle with another fissure (c), which extends from before backwards, and which is bounded externally by the middle lobe, internally by the crus cerebri and tractus opticus, and deserves notice because it transmits the pia mater from the external surface into the lateral ventricle.

The angular part of the anterior lobe, which is included between the internal termination of the fissure of Sylvius, the longitudinal fissure, and the commissure of the optic nerves, has been named by Vicq-d'Azyr *substantia perforata antica* (d), and by Reil *lamina cribrosa*, because it presents several foramina for the transmission of vessels. It deserves attention, inasmuch as the white lines seen at its inner border are continuous with those of the corpus callosum.

Optic commissure (v).—Between the fissuræ Sylvii, and corresponding with the interval between their internal terminations, is situated the *commissure of the optic nerves*. It is flat and quadrilateral in its form: one surface looks upward to the brain, and is connected with the anterior termination of the corpus callosum, which passes upon it in the form of a thin semi-transparent lamella; the other surface rests upon the depressed part of the sphenoid bone, which lies before the pituitary fossa; the lateral and anterior margins are free, but the posterior one is intimately connected with a delicate stratum of grey matter, which is inserted between the nerves as they converge to their commissure.

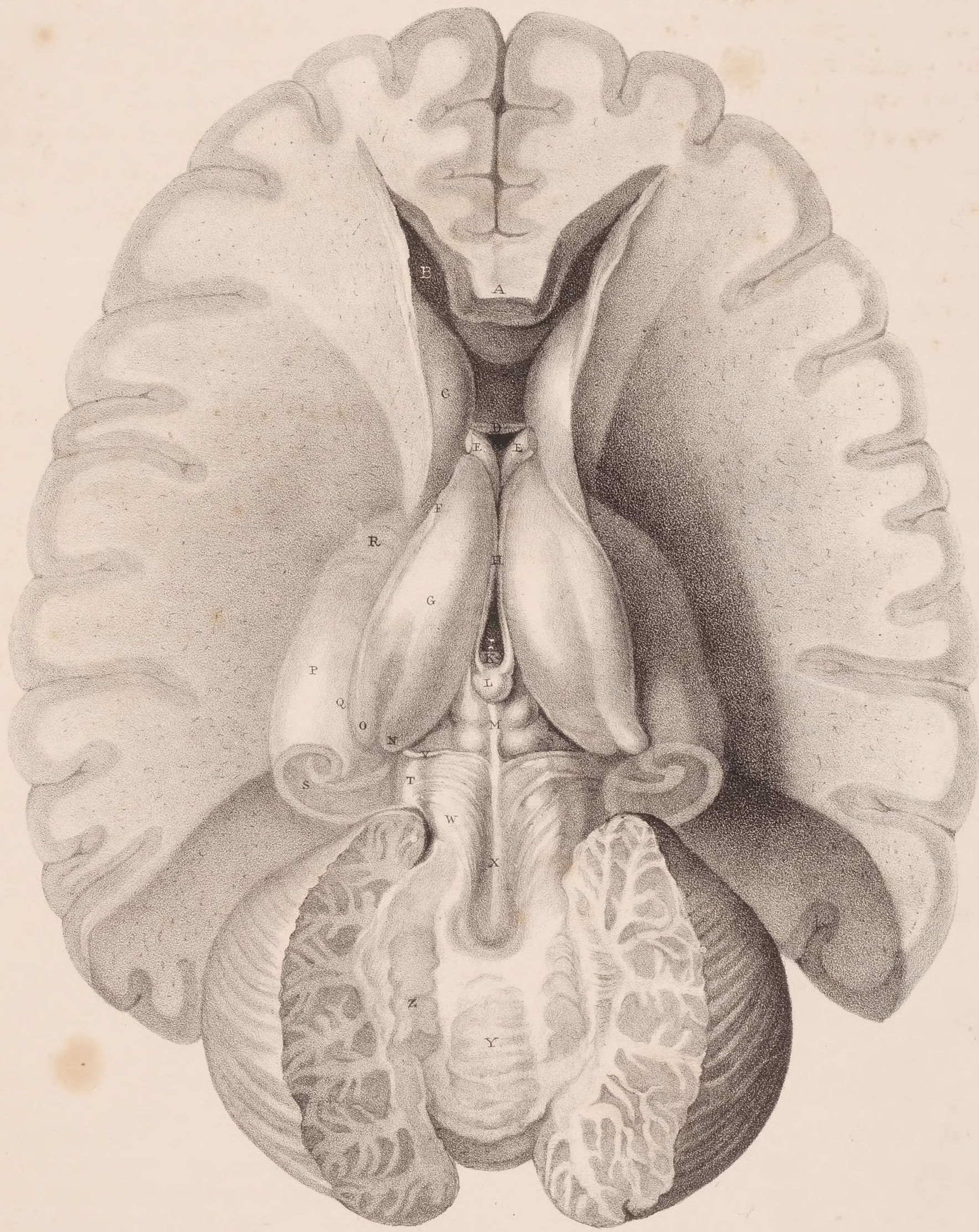
Tuber cinereum (e).—The piece of grey matter just referred to is called by Sœmmering *tuber cinereum*: it extends from the posterior margin of the optic commissure to the corpora albicantia, gradually becoming a little thicker and firmer; for in front it is so thin as to be torn by the slightest

PLATE VI.

Upon removing the velum interpositum, shown in the last plate, the third ventricle, the fissure between the thalami optici, is brought into view. The hemispheres on each side have been deeply excavated, and a large part of the corpora striata cut away so as to display the extremities of the middle cornua, and the large bodies, hippocampi majores, which occupy them. Posteriorly, the upper portion of the cerebellum has been removed to show the position and appearance of the fourth ventricle, previously to the rupture of the valve of Vieussens.

- A. The anterior extremity of the corpus callosum. B. The anterior cornu of the lateral ventricles. C. Part of the corpus striatum. D. The anterior commissure of the third ventricle. E, E. The crura of the fornix descending through the foramen commune anterius. F. The tenia semicircularis. G. The thalamus opticus. H. The fissure between the thalami optici, which is called the third ventricle. I. The foramen commune posterius. K. The posterior commissure of the third ventricle. L. The pineal gland connected to the thalami optici by its two peduncles. M. The corpora quadrigemina. N. The corpus geniculatum internum of the thalamus opticus. O. Part of the corpus geniculatum externum; the rest has been removed with the hemisphere. P. The hippocampus major. Q. The corpus fimbriatum attached to the concave border of the hippocampus major. R. The pes hippocampi. S. The cut surface of the hippocampus major, showing the convoluted arrangement of the grey and white substance of which it consists. T. The upper surface of the crus cerebri. V. The fourth nerve arising from the valve of Vieussens, close to the corpora quadrigemina, and winding around the crus cerebri. W. The processus e cerebello ad testes. X. The valve of Vieussens. Y. The middle portion of the cerebellum connecting the two lateral lobes. Z. The corpus rhomboideum, in the centre of the white substance of the cerebellum.

Plate 6.



W.J.L. Wilson delin.

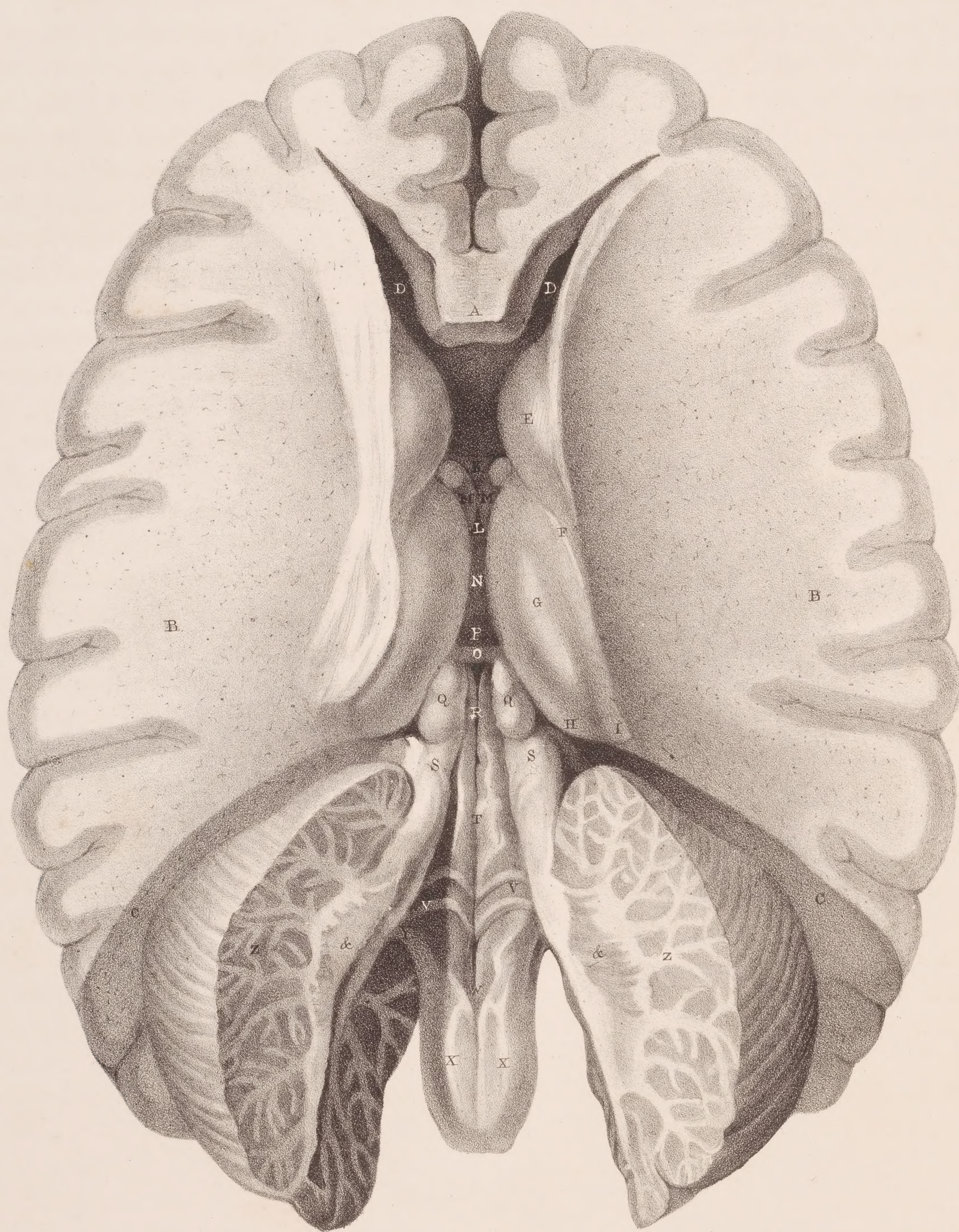
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Plate 7.



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touch. Its superior surface forms part of the floor of the third ventricle; the inferior one is slightly convex, and gives attachment by its centre to a funnel-shaped process, called *infundibulum* (f; plate IX. fig. 1, c; tige pituitaire). This is a thin elongated process of reddish grey matter, inclined obliquely downwards and forwards from the tuber cinereum to the pituitary gland; its extremities are slightly expanded, and its centre constricted, which gives it an hour-glass shape.

Pituitary gland or body (plate IX. fig. 1, d).—The pituitary gland appears to have received its name from its being supposed, in the infancy of anatomy, to communicate with the nose, and to secrete the viscid mucus (pituita) of that cavity; it is lodged in the excavation in the upper surface of the body of the sphenoid bone, and is unequally divided into two portions or lobes: the anterior, which is larger and more firm than the other, is convex in front, and concave behind, so as to receive the other, whose border is round and convex. The situation of the pituitary gland is peculiar: it is interposed between the two lamellæ of the fibro-serous membrane. The dura mater will be found to line the surface of the bone on which the gland rests; but the arachnoid membrane, after having formed a funnel-shaped process round the infundibulum, is reflected off from it at its lower extremity, and stretched across the upper surface of the gland until it reaches the clinoid processes, where it becomes continuous with the inner lamella of the fibro-serous membrane. When cut into thin slices, it appears to consist of two substances, one being reddish grey, the other white.

Mammillary bodies (plate VIII. g).—Immediately behind the tuber cinereum are placed two small bodies, called corpora mammillaria (albicantia, pisiformia). Their size is about that of a pea, but they are not quite round, being slightly compressed on three sides. Placed in apposition with one another, they are connected by a delicate process of grey matter, of which substance the greater part of their mass consists; they are, however, invested by a lamella of white matter, derived from the anterior pillars of the fornix, of which they may be regarded as the termination.

Behind the mammillary bodies is situated a thin lamella of white substance, which is pierced by a number of foramina, for the transmission of vessels, and called *locus perforatus* (h), and sometimes *pons Tarini*. Its shape is triangular, the sides being formed by the crura cerebri, the base by the mammillary bodies, the apex being at the border of the pons Varolii; it forms part of the floor of the third ventricle.

The *crura cerebri* (i) are two thick rounded bodies, about three-fourths of an inch long, and situated towards the centre of the base of the brain, from which they project rather prominently. They are extended from the pons Varolii forwards and upwards to the under surface of the hemispheres, into which they seem as if inserted. They are nearly in contact behind, but diverge as they pass forwards, so as to leave an interval, which is occupied by the locus perforatus. The external surface of the crura consists of white matter, which is about two lines thick, and presents a distinctly fibrous character; within this is enclosed a quantity of grey substance, so dark as to have received the name

PLATE VII.

In this view of the brain the hemispheres have been slightly separated from each other, in order to bring more clearly into view the commissures of the third ventricle; the corpora quadrigemina have been divided along the median line to show the canal which is situated beneath them; and the middle third of the cerebellum has been removed, and the valve of Vieussens broken down, to display the fourth ventricle. The plane of the corpus callosum is preserved at the anterior part, to enable the student to compare the depth of the various sections that have been made to expose the different layers.

A. The anterior part of the corpus callosum. B, B. The middle lobes of the hemispheres, sliced downwards nearly to the base of the brain. C, C. The divided surface of the posterior lobes of the brain, which have been removed to make room for the expansion of the cerebellum. D, D. The anterior cornua of the lateral ventricles. E. The corpus striatum of the right side. F. The tenia semicircularis of the same side. G. The right thalamus opticus. H. Its corpus geniculatum internum. I. Part of the corpus geniculatum externum. K. The anterior commissure connecting the corpora striata of either side. L. The foramen commune anterius occupied by, M, M, the two crura of the fornix passing downwards to the corpora albicantia. N. The soft commissure (commissura mollis). O. The posterior commissure. P. The foramen commune posterius. Q, Q. The corpora quadrigemina, divided and drawn apart to show the canal, R, named iter à tertio ad quartum ventriculum. S, S. The remains of the valve of Vieussens turned aside over the white rounded cords, the processus e cerebello ad testes. T. The cavity of the fourth ventricle. V, V. The white transverse lines (lineæ transversæ) of the fourth ventricle, the origins of the auditory nerves. W. The calamus scriptorius. X, X. The corpora restiformia, or posterior pyramids. Y. The corpus restiforme of the left side, seen entering the white substance of the cerebellum. Z, Z. The arborescent structure of the cerebellum, called arbor vitæ. &. The corpus rhomboideum, in the centre of the white substance of the cerebellum.

NERVES.

E

of *locus niger*. The arrangement of these structures can be readily seen by making a transverse section of the crus: the dark part is found to be convex inferiorly, and concave above, so that the section of it presents a lunated form. The optic nerves rest upon the external surface of the crura as they pass forwards to their commissure.

The *great Commissure—corpus callosum* (plate III. A, A).—All the parts of the brain hitherto noticed can be examined without any division of its texture, as they are placed superficially; but several are enclosed within its interior, which cannot be seen without dissection. Between the hemispheres, and extending transversely from one to the other, is placed the *corpus callosum* (meso-lobe, commissura magna cerebri); its form is that of a broad layer of white fibres placed horizontally, but nearer to the anterior than to the posterior margin of the brain. Its extent from before backwards is about three inches, but its breadth from side to side cannot be assigned, as it becomes blended with the substance of the hemispheres. Its superior surface is convex in its general outline, and concealed by the hemispheres, which overlap it. When these are removed, a superficial linear impression (B) will be perceived exactly in the middle line, and at each side of it a slight longitudinal elevation. To this the term *raphé*, or suture, is applied, as it indicates the point at which the union of the hemispheres takes place when their development is being completed. The fibres obviously are transverse from without inwards, for they commence at the circumference of the hemispheres, and terminate by their junction along the *raphé*. The inferior surface of the corpus callosum forms the roof of the lateral ventricles on each side, and towards the middle line it rests on the fornix, with which it is blended posteriorly: in front it gives attachment to the septum lucidum. Its anterior extremity, which, when viewed externally, presents a rounded border, is prolonged downwards and backwards to the base of the brain, where it forms a thin semi-transparent lamella. This reflected part (plate IX. fig. 1, C) is nearly horizontal in its direction, so that it lies beneath the corpora striata, and above the commissure of the optic nerves, to which it adheres, but still passes backwards, and becomes continuous with the tuber cinereum in the middle line, whilst at each side its margins are blended with the substantia perforata. The posterior border of the corpus callosum (plate IX. fig. 1, D) is thick and rounded at the middle line, its thickness being greater (as may be seen when it is cut through perpendicularly) than that of the anterior border, owing to its receiving a greater number of converging fibres from the posterior lobes. A little more externally, the border of the corpus callosum gives off at each side two fasciculi of fibres, which can be traced, one into the posterior, the other into the descending cornu of the ventricle; one of these forms the medullary investment of the hippocampus minor, the other that of the hippocampus major.

Lateral ventricles (plate IV.; ventriculi tricornes).—Beneath the corpus callosum are situated the lateral ventricles, occupying the interior of the hemispheres. Their shape is very irregular, and can scarcely be said to bear a resemblance to any known figure. Each of them may be considered as divisible into a body or central portion, and three cornua or diverticula, which pass away in different directions. The central part lies horizontally: one cornu extends forwards from it into the anterior lobe, another backwards into the posterior, and the third downwards into the middle one; each of these presents certain peculiarities referable to the parts seen within them, which deserve notice. In the central part will be observed the corpus striatum, and thalamus nervi optici, and between them the tænia semicircularis; also the margin of the fornix, and part of the plexus choroides. These objects are for the present merely enumerated; each of them shall be noticed separately.

Septum inter ventriculos (plate IV. B; plate IX. fig. 1, I).—Previously to describing the objects just named, it may be observed that the lateral ventricles are separated by a partition (*septum lucidum*), which extends from the corpus callosum perpendicularly down to its reflected lamella in front, and to the fornix behind; it is round and broad before, but becomes narrowed to a point posteriorly. It consists of two thin lamellæ of white substance, between which is a fissure, or interval, called the *fifth ventricle*.

Fornix (plate IV. E, E; plate IX. fig. 1, E).—Beneath the corpus callosum and septum lucidum is a triangular lamella of white matter, which is extended from behind forwards over the third ventricle, and is thence termed *fornix*. Its upper surface gives attachment to part of the septum lucidum, and posteriorly becomes united with the corpus callosum; the inferior one overlays the third ventricle and the thalami nervorum optidorum, but is separated from them by the velum interpositum. Some oblique lines are traced on this surface, on which account it has been termed *lyra*, or *corpus psalloides*. The anterior extremity of the fornix is narrow, and divides into two fasciculi (F, F; *pillars of the fornix*), which curve downwards at the fore part of the third ventricle, immediately behind the anterior commissure, and terminate at the base of the brain by investing the corpora mammillaria.

The base or posterior extremity of the fornix gives off at each angle a thin flat process (plate V. R), which passes into the descending cornu of the ventricle, and assumes the name of *corpus fimbriatum*.

The *anterior cornu* (plate IV. G) of each ventricle inclines forwards and outwards, diverging from its fellow of the opposite side; the corpus striatum (M; its fore part) projects a little into its floor: the remainder of it resembles a groove in the cerebral substance. The *posterior cornu* (H) called the *digital cavity*, converges towards that of the opposite side, and presents in its floor the *hippocampus minor* (I; calcar, unguis). This is a slight elevation, composed of a lamella of white matter (continuous with, or derived from, the corpus callosum), enclosing some cineritious substance; it gradually tapers to a point, and reaches to within an inch of the posterior extremity of the hemisphere.

The *inferior* or *descending cornu* (plate IV. K; plate V.) passes at first backwards and outwards from the body of the ventricle; but, after descending a little, it changes its direction altogether, and proceeds forwards and inwards, to terminate at the base of the brain, within a few lines of the fissure of Sylvius. This is the largest of the cornua: its convexity looks outwards and backwards, its concavity in the opposite direction: the under surface of the thalamus forms its roof, and the plexus choroides rests loosely on its floor, concealing the hippocampus major and corpus fimbriatum.

The *hippocampus major* (plate V. P; cornu ammonis) resembles in shape a cerebral convolution; it is curved so that its convex border looks outwards, and the concave inwards, conforming with the direction of the cavity in which it lies. Its anterior extremity expands somewhat, and presents two or three, and sometimes as many as five small prominences, separated by slight depressions, which make it to resemble somewhat the back of the hand when shut close. Some of the older anatomists called it *pes hippocampi* (Q), from its resemblance to the clubbed foot of some of the lower animals. External to the part where the cornu makes its curve forwards, a slight elevation is observed, which is called *pes accessorius*.

Corpus fimbriatum (R).—Along the inner border of the cornu is a narrow falciform process of white substance (corpus fimbriatum), which is adherent by one edge to the floor of the cornu. It gradually becomes narrow, and ends in a point a little behind the pes hippocampi. Near the inner border of the corpus fimbriatum a narrow line of cineritious substance (*fascia dentata*) is placed; it is not perceptible until the middle lobe, together with the inferior cornu of the ventricle, is drawn outwards, as it is excluded from the cavity of the cornu by the reflection of the arachnoid membrane; its free border is marked by several transverse notches, giving it a dentated appearance, from which its name is derived.

The cornu ammonis consists externally of a lamella of white substance, which, if traced upwards into the body of the ventricle, will be found continuous with the corpus callosum. The corpus fimbriatum, in like manner, will be found continuous with the fornix.

The *corpora striata* (plate IV. M, plate V. E; ganglions cérébraux supérieurs, Gall) are two in number, situated one in the body of each lateral ventricle. Each of these bodies is pyriform in its shape, the larger extremity being turned forwards and inwards, the smaller backwards and outwards. The superior surface is smooth and slightly prominent in the cavity, all the rest being imbedded in the substance of the hemisphere. Their position is so oblique, that though in front they are separated by not more than three or four lines, their posterior extremities are from an inch and a half to two inches apart, the interval being occupied by the optic thalami and the third ventricle. Their external surface is composed of grey substance, but internally the grey and white are intermingled, so as to produce a striated appearance, whence the name is derived. The white fibres here found are continuous with those of the anterior pyramids and of the crura cerebri (plate IX. fig. 2, H; plate X). They spread out considerably as they pass through the mass of grey matter of which the corpora striata consist, and appear to be at the same time enlarged and increased. Hence these bodies are considered by Dr. Gall to be ganglia of encrease placed in the course of the fibres which are diverging to form the cerebral hemispheres.

The *optic thalami* (plate IV. O, plate VI. G; thalami nervorum opti-corum, ganglions cérébraux postérieurs, Gall) are placed behind and between the corpora striata. The upper surface of each projects into the body of the corresponding ventricle; the inferior one forms the roof of its descending cornu, and the external is blended with the corpus striatum and the substance of the hemisphere. The internal surface of each thalamus, which is contiguous to that of the opposite side, is united to it by a soft lamella of grey substance called the *soft commissure* (plate VI. H, plate VII. N; commissura mollis). The union, however, may be called partial, for before and behind the commissure a small interval exists, where the thalami are unconnected, being merely in apposition.

Corpora geniculata.—On the posterior border of each thalamus are observed two slightly raised papillæ (plate VI. N, O; *corpus geniculatum internum et externum*), which are connected by medullary striæ to the tubercula quadrigemina, the external one being also united to the origin of the optic nerve.

Tænia semi-circularis.—The contiguous borders of the optic thalamus and corpus striatum are separated by a thin fasciculus of nervous matter, of a pale straw colour (plate IV. N; *tænia semi-circularis*), commencing near the anterior pillar of the fornix; it extends from before backwards between the bodies just named, and can be traced as far as the posterior border of the thalamus, and for a little way into the roof of the descending cornu, where it seems to cease.

Pineal gland and its peduncles (plate VI. L).—Along the inner margins of the thalami two delicate white fasciculi arise, and pass backwards, converging to the pineal gland, whose *peduncles* they form, and at the same time constitute its only bond of connexion with the substance of the brain. The pineal gland is a small mass of grey substance of a conical shape, and is sometimes called *conarium*, occasionally also *acervulus*. Its base rests on the tubercula quadrigemina; it usually contains in its interior some sabulous matter; at its first formation it consists of two masses, which unite into one.

The *third ventricle* (plates VI. and VII).—The optic thalami enclose between them a narrow cavity (*third ventricle*), which corresponds exactly with the middle line, and resembles a longitudinal fissure. Its sides are formed by the thalami, its floor by the locus perforatus and tuber cinereum; the velum interpositum and fornix cover it in. The anterior commissure, and the pillars of the fornix, bound it in front. Into this cavity leads an aperture (plate VII. L; *foramen commune anterius*, *foramen Monroi*), which is a rima between the anterior pillars of the fornix and the thalami, and which establishes a communication between the third and the lateral ventricles; a foramen leads out of it downwards and forwards (*iter ad infundibulum*). It may be observed that the infundibulum becomes imperforate at its middle, which appears to be owing to a small cul-de-sac of arachnoid membrane which is prolonged into it. From the posterior extremity of the ventricle another foramen (plate VI. I, plate VII. P; *foramen commune posterius*) opens into a canal (plate VII. R; *iter à tertio ad quartum ventriculum*; *aquæductus Sylvii*), which leads obliquely downwards and backwards into the fourth ventricle.

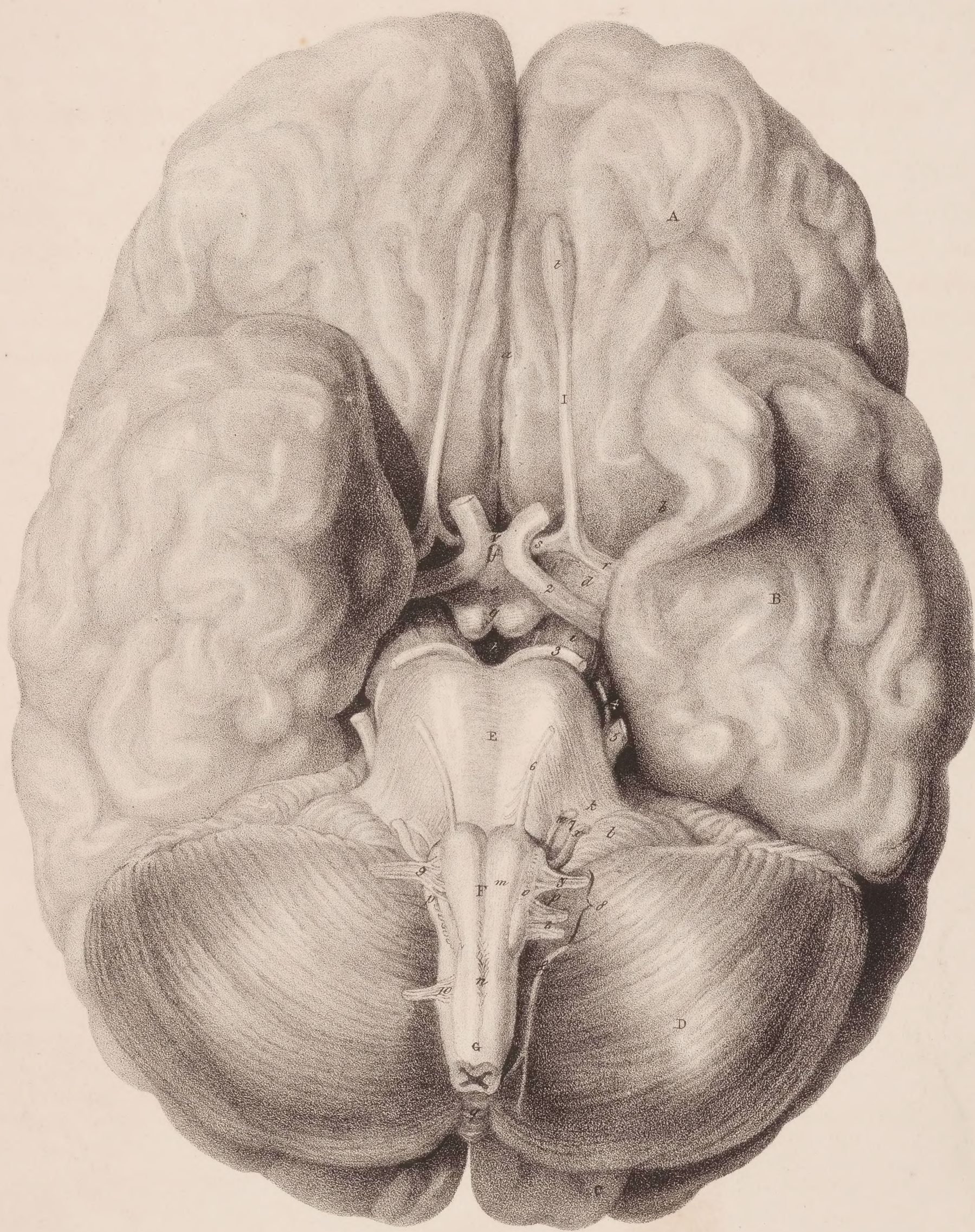
Commissures, anterior and posterior.—Two cord-like fasciculi are stretched across the extremities of the third ventricle, and prolonged into the hemispheres which they connect, serving as commissures. The *anterior commissure* (plate VI. D; plate VII. K) lies just before the pillars of the fornix, and as it extends laterally it will be found imbedded in the substance of the corpora striata at each side, but does not become blended with them; its extremities arch backwards a considerable way, so

PLATE VIII.

The base of the brain, displaying the origins of the cerebral nerves.

- A. The anterior lobe of the brain. B. The middle lobe. C. A small portion of the posterior lobe, seen projecting beyond the cerebellum. D. The right lobe of the cerebellum. E. The cerebral protuberance, or Pons Varolii. F. The medulla oblongata. G. Commencement of the spinal cord, divided by a transverse section which displays its internal structure.
- a. The longitudinal fissure of the brain, separating the two anterior lobes. b. The fissure of Sylvius. c. The fissure through which the pia mater enters the lateral ventricles. d. The substantia perforata antica. e. The tuber cinereum. f. The infundibulum. g. The corpora mammillaria (albicantia). h. The locus perforatus, or pons Tarini. i. The crus cerebri of the right side. k. The crus cerebelli of the right side. l. The lobular appendix of the cerebellum (lobulus nervi vagi; flocculus). m. The corpus pyramidale of the right side. n. Decussation of the fibres of the corpora pyramidalia in the medulla oblongata. o. Corpus olivare. p. Corpus restiforme. q. The inferior vermiform process of the cerebellum.
1. The first cerebral nerve,—olfactory.
- r. Its external root. s. Its internal root. t. The olfactory bulb (bulbus olfactorius).
2. The second, or optic nerve.
- v. Its commissure.
3. The third nerve (motores oculorum). 4. The fourth nerve (nervus patheticus, n. trochlearis). 5. The fifth nerve (nervus trigeminus; trifacial). 6. The sixth nerve (nervus abducens). 7. The seventh pair.
- w. The facial nerve (nervus facialis; portio dura). x. The auditory nerve (nervus auditorius; portio mollis).
8. The eighth pair.
- y. The glosso-pharyngeal nerve (nervus glosso-pharyngeus). z. The pneumo-gastric nerve (nervus vagus; par vagum). &. The spinal accessory nerve (nervus accessorius).
9. The ninth nerve (nervus lingualis; hypo-glossus). 10. The anterior root of the first spinal nerve.

Plate 8.



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Plate 9.

Fig 1.



Fig 2.



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as to form a curve whose convexity looks forwards. The *posterior commissure* (plate VI. K; plate VII. O) is much shorter than the preceding, and extends but a few lines on each side into the thalami; it lies behind the ventricle, before the tubercula quadrigemina, and above the aqueduct of Sylvius.

The cerebellum (plates V. VI. VII. VIII. and IX. fig. 1).—The second division of the central mass of the nervous system is the cerebellum, which differs in situation and size, as well as in the arrangement of its component parts, from the cerebrum. It is lodged in the recess formed between the tentorium cerebelli and the inferior occipital fossæ, its weight as compared with that of the brain being as 1 to 16 in the infant, and as 1 to 8 in the adult. Its surface, instead of convolutions, is divided into a number of concentric lamellæ (*folia cerebelli*), placed perpendicularly on their edges, and enclosed one within the other. If, however, the sulci between them be opened, several other lamellæ will be found enclosed within them, but smaller, more irregular, and with various degrees of inclination.

Lobes.—The cerebellum is divided into two lateral lobes, the division being established behind by a fissure, which receives the falx cerebelli, and in front by a deep excavation, which lodges the medulla oblongata.

Superior vermiform process (plate V. X).—The superior surface of the cerebellum is slightly depressed on each side where the tentorium rests upon it, but along the middle line a rounded ridge (processus vermiformis superior) runs from before backwards, and seems as if produced by the rippling up or admixture of the lamellæ of the lobes as they extend from without inwards. There

PLATE IX.

Fig. 1. Represents a longitudinal section of the cerebrum and cerebellum, made perpendicularly between the two hemispheres.

A, A. The internal convolutions of the right cerebral hemisphere. B. The corpus callosum. C. The anterior extremity of the corpus callosum turning downwards towards the base of the brain. D. The posterior folded border of the corpus callosum, becoming continuous with, E, the fornix. F. The right crus of the fornix descending to, G, the corpus mamillare (albicansium). H. The band of white fibres passing from the corpus mamillare into the thalamus opticus. I. The septum lucidum. K. The foramen of Monro. L. The divided edge of the velum interpositum. M. The central part of the fissure of Bichât, through which the trunk of the venæ Galeni, N, is seen escaping from the brain. O. The anterior commissure of the third ventricle. P. The middle commissure (commissura mollis). Q. The posterior commissure. R. The right thalamus opticus. S. The right peduncle of the pineal gland. T. The pineal gland. U. The corpora quadrigemina. V. The Iter à tertio ad quartum ventriculum. W. The divided edge of the valve of Vieussens. X. The processus è cerebello ad testes. Y. The fourth ventricle. Z. Section of the cerebellum, showing the arrangement of the white and grey substance named arbor vitæ.

1. The olfactory nerve.
- a. The substantia perforata antica.
2. The optic nerve of the right side.
- b. The tuber cinereum. c. The infundibulum. d. The pituitary gland. e. The crus cerebri of the right side. f. The locus perforatus.
3. The third nerve (n. motorius oculi).
- g. The middle lobe of the brain of the right side. h. Section of the pons Varolii, through which the ascending fibres of the corpus pyramidale, i, are seen separated by grey matter as they pass onwards to the crus cerebri. k. Section of the inferior transverse or converging fibres of the pons Varolii. l. Section of the superior transverse or converging fibres of the pons Varolii. m. Section of the medulla oblongata.

Fig. 2. In this drawing the developement of the brain from the primitive fasciculi of the medulla oblongata, and the formation of the diverging fibres, described by Gall and Spurzheim, are exhibited. A section has been made through the outer third of the medulla oblongata and cerebellum; the crus cerebelli has been divided, and the outer convolutions of the right hemisphere carefully raised in the direction of the fibres.

A. The medulla oblongata. B. The corpus pyramidale. C. The fibres of the corpus pyramidale expanding in the grey substance of the pons Varolii. D. The pons Varolii. E. The divided edge of the transverse or converging fibres of the pons Varolii. F. The passage of the fibres of the corpus pyramidale through the crus cerebri. G. The course of the fibres through the thalamus opticus, the inferior cerebral ganglion of Gall. H. The corpus striatum (superior cerebral ganglion, Gall), from which the fibres diverge to the convolutions of the middle and anterior lobes. I. The lower part of the middle lobe of the cerebrum. K. The anterior lobe. L. The posterior lobe. M. The corpus olivare. N. The ganglion of the corpus olivare. O, O. The course of the fibres of the corpus olivare through the pons Varolii, crus cerebri, thalamus opticus, and corpus striatum, to expand into the upper convolutions of the hemisphere and posterior lobe. P. The corpus restiforme. Q. The fibres of the corpus restiforme entering the substance of the cerebellum. R. The corpus dentatum (vel rhomboideum), or ganglion of the cerebellum. S. The processus è cerebello ad testes, or fibres of communication between the cerebellum and cerebrum.

appear to be from sixty to seventy lamellæ on the upper surface of the cerebellum, which are aggregated into five fasciculi.

Inferior vermiform process (plate VIII. q).—The inferior surface is convex, and dips down into the occipital fossæ; along the middle line runs the *inferior vermiform process*, interposed between the lateral lobes; it resembles a lobule formed of short transverse plates; its anterior extremity has been compared to a mammillary process.

The mass of medullary matter enclosed within the cerebellum is connected with three pairs of medullary fasciculi; viz. *processus è cerebello ad testes*, *corpora restiformia*, and *crura cerebelli*, which require a detailed notice.

Processus è cerebello ad testes (plate VI. W; plate VII. S).—From the interior of the lobes, two fasciculi of white fibres pass forwards and upwards to the lower pair of the tubercula quadrigemina; the name given to them indicates the points between which they lie; they converge in their ascent, and are connected by a semi-transparent medullary lamella, named the valve of Vieussens. The valve (*valvula Vieusseni*; plate VI. X) presents on its upper surface a slight groove, running from above downwards, and sometimes a linear ridge, like a raphé; it overhangs the fourth ventricle.

Posterior pyramids (plate VII. X, X: *corpora restiformia*, *pyramides postérieures*).—Two white rounded processes pass obliquely upwards and outwards from the medulla oblongata into the cerebellum, named by Ridley “restiform” bodies, by Gall “posterior pyramids;” we have already noticed them as part of the medulla oblongata.

Peduncles of the cerebellum (plate VIII. k; *crura cerebelli*).—These are the largest of the fasciculi here referred to; they are at first concealed within the lobes, and even when about to emerge from their substance, they are overlapped by some minor lobules. They incline forwards and inwards, descending somewhat, and become continuous with the fibres of the pons Varolii, which are thus derived from the *crura cerebelli*. The pons, from its mode of formation, bears the same relation to the cerebellum that the corpus callosum does to the cerebrum, as it is composed of converging fibres, and may therefore be called a commissure.

Fourth ventricle (plate VII. T).—The cerebellum encloses a cavity called the “fourth ventricle,” the roof of which is formed by the valve of Vieussens and *processus ad testes*, the sides by the lobes of the cerebellum; the dorsal surface of the medulla oblongata forms its floor, and it is completed inferiorly by a reflection of the arachnoid membrane: a process of pia mater projects into it at this situation, called *plexus choroides minor*.

Corpus dentatum (plate IX. fig. 2, R; plate X. U).—If a vertical section be made of one of the lobes of the cerebellum, in such a way as that two-thirds of its breadth shall lie external to the incision, an oval nucleus of grey substance (*corpus dentatum*, vel *rhomboideum*) will be exposed: its texture is usually firm, and its border notched, so as to give it a dentated appearance. Gall considers it as a ganglion of increase to the formative fibres of the cerebellum. The surface of the section here indicated presents rather a peculiar appearance: the white substance will be found so disposed as to represent the stalk and branches of a tree, hence called *arbor vitæ*. The branches project into the lamellæ of the cerebellum, which are not unfrequently in figurative phrase termed *folia*, for the grey substance invests them so as to make them resemble pinnatifid leaves. If a horizontal section be made, so as to divide the lobe into two equal parts, the quantity of white substance will appear considerably greater than that of the grey.

Cerebral protuberance.—The cerebral protuberance (plate VIII. E; plate IX. fig. 1, h; fig. 2, D; plate X. I, V: *nodus cerebri*, *pons Varolii*, *protuberantia annularis*) is much the smallest portion of the central mass; its relative size being to that of the rest as 1 to 72. It is placed beneath the cerebrum, above the medulla oblongata, and before the cerebellum, having intimate relations with each by continuity of substance; hence it has been termed *nodus encephali*. It is a square mass, its depth being about equal to its length. Its anterior surface is convex, and rests against the basilar process of the occipital bone, and is composed of the converging fibres of the cerebellum, disposed so as to form a portion of a ring, which encloses the contiguous extremities of the *crura cerebri* and medulla oblongata;—it is termed *protuberantia annularis*, or *pons Varolii*. Its upper border is bounded by a transverse line, marking its separation from the *crura cerebri*, and the lower by another line, which divides it from the medulla oblongata; along its middle is a shallow groove, running from above downwards, which corresponds with the basilar artery.

Tubercula quadrigemina (plate VI. M).—Upon the posterior surface of the cerebral protuberance, which is almost entirely concealed by the cerebellum, are placed four white rounded bodies (*tubercula*, vel *corpora quadrigemina*), disposed in pairs, one above the other, and separated by two

decussating lines. The upper pair are the larger, and called *nates*—the lower, *testes*; they are connected in front with the thalami, inferiorly with the processus ad testes and the valve of Vieussens, and between their upper surface and the corpus callosum is a rima or fissure (*fissure of Bichât*), through which the arachnoid membrane enters to line the ventricles.

Communication between the ventricles of the brain.—The irregular vacuities disposed in the interior of the cerebellum and brain communicate freely with one another by certain constricted portions, or foramina. If, whilst the brain and cerebellum remain *in situ*, the latter be divided by a vertical incision made from the valve of Vieussens downwards through its substance, the fourth ventricle will be exposed. This cavity contracts towards its upper part into a tube (aqueduct of Sylvius), which is directed upwards and forwards, under the tubercula quadrigemina and the posterior commissure, into the middle or third ventricle. The latter again communicates at each side with the lateral ventricles by a rima (*foramen Monroi*), situated between the pillars of the fornix and the thalami, on which they rest. When the ventricles have been distended with fluid, this rima assumes a rounded form, and then only represents a foramen. These vacuities, then, should be considered not as so many separate cavities, but as a series of compartments of one cavity contained within the cerebral mass; and this is the appearance they present during the early periods of foetal life. The cavity, however, is not a shut sac, for the membrane which lines it is continuous with that which invests the external surface of the brain and cerebellum. It has been already stated, that the arachnoid membrane passes in through the fissure of Bichât. Two other fissures are situated, one on each side between the corpus fimbriatum and the crus cerebri, through which the pia mater enters, to form the plexus choroides. These may be considered as chinks between the portions of cerebral substance just referred to; but they are closed up by the manner in which the arachnoid membrane is reflected from the sides of the cornua of the ventricles upon the plexus choroides.

Structure of the brain (plate IX. fig. 2; plate X).—The cerebral hemispheres are considered by Gall as resulting from an expansion or evolution of the fibres of the medulla oblongata, which he therefore terms primitive, or formative fasciculi.

Diverging fibres (plate X).—The fibres of the anterior pyramids may be traced upwards to the margin of the pons, where they become somewhat constricted. From the inner border of each, some fibres pass across the middle sulcus, and mutually change place, or decussate; those of the right side passing to the left, and *vice versâ*. If an incision, a line or two in depth, be made through the pons, so that one lateral half of it may be turned outwards, the fibres of the pyramid will be observed to pass into a quantity of grey substance (W) lodged in the interior of the nodus encephali. In this situation the fibres diverge and separate, and are also considerably increased: at the upper margin of the pons they become continuous with the crus cerebri (X). Here an additional increase is derived from their passage through the grey substance lodged in the interior of the crus, after which they proceed through the inferior cerebral ganglion (Y; *thalamus nervi optici*), and in the next place through the superior one (Z; *corpus striatum*), being successively increased and rendered still more divergent, until finally they reach the anterior and middle lobes (a, a), where they are evolved into their inferior, external, and anterior convolutions. The corpus olivare contains within itself a small ganglion (plate IX. fig. 2, N); its fibres pass, without any decussation, into the grey substance lodged in the cerebral protuberance, where, like the pyramids, they receive additions, after which they pass into the crus cerebri (O, O), of which they form the posterior and inner part. Continuing their ascent, after being increased in the locus niger, they pass through the optic thalamus, and thence into the corpus striatum, receiving additions as they radiate through each, and finally are continued upwards into the convolutions at the summit of the hemisphere, and backwards into those of the posterior lobe. Previously to entering the optic thalamus, some fibres of the corpus olivare have been observed to turn inwards, so as to give to the tubercula quadrigemina their medullary investment, and also to unite with those of the opposite side, to form the valve of Vieussens. Finally, the diverging fibres traced up, as has been pointed out, through their successive steps of increase, terminate in the grey substance of the cerebral convolutions.

Converging fibres.—Another order of fibres may be observed quite distinct from those above noticed, and taking a different direction. These are called the “converging fibres,” as they commence at the peripheral terminations of the preceding set, and pass from without inwards to the middle line, so as to connect the lateral parts, and bring them into relation with one another; on which account they are called commissures. The anterior and posterior commissures are formed in this way, as is also the corpus callosum; though the greater number of the fibres which compose the latter are transverse, those towards its extremities are oblique. This is owing to the manner in which the converging

fibres of the anterior lobe are constrained to pass from before backwards, and those of the posterior lobe from behind forwards, in order to gain the corresponding borders of the corpus callosum. By this arrangement a greater number of fibres is collected to its extremities, which renders them thicker (particularly the posterior one) than any other part of its extent. Some of the inferior fibres thus traced from without inwards, instead of uniting with the corresponding set along the middle line, become reflected downwards from the under surface of the corpus callosum to the fornix, and so form the septum lucidum. The convolutions of the posterior lobe are brought into relation with those of the middle one by means of the fornix, the fibres of which are stretched from behind forwards, in such a way, that whilst its body is in a manner unattached, the extremities are identified with the parts just referred to.

Diverging fibres of the cerebellum (plate IX. fig. 2, Q ; plate X. T).—The formative fibres of the cerebellum are derived from the posterior pyramids, or corpora restiformia ; they pass upwards and outwards, and soon meet the corpus rhomboideum, which is considered as the ganglion of the cerebellum : the fibres are supposed to proceed through the grey substance of which it is composed, though it is difficult to demonstrate the fact ; after which they pass outwards, diverging into the lobes of the cerebellum.

Converging fibres.—From the peripheral terminations of the diverging fibres in the folia, a new set arise, which incline inwards towards the middle line. These are the converging fibres, which, by their union, form the crura cerebelli ; and the fibres of each crus, expanding as they pass downwards and inwards, constitute by their junction the pons Varolii, which brings the lateral lobes of the cerebellum into relation, and becomes thereby their commissure. The processus à cerebello ad testes bring the lobes of the cerebellum into intimate connexion with the cerebral hemispheres.

The weight of the brain in the adult is about three pounds ; that of the cerebellum about four ounces and a half, and of the medulla oblongata half an ounce.

PLATE X.

The developement of the cerebrum and cerebellum from the primitive fasciculi of the medulla oblongata, traced from the base of the brain, is here shown.

On the right side, the base of the brain is left nearly entire ; on the left side, the converging fibres of the pons Varolii have been removed, and a section made through the crus cerebri towards the circumference of the hemisphere, to display the course and radiation of the diverging fibres.

A. The anterior lobe of the right hemisphere. B. Its middle lobe. C, C. The posterior lobes of both hemispheres. D. The crus cerebri of the right side. E. A section of the inner border of the middle lobe, showing the expansion of some of the fibres of the crus cerebri. This section was made to bring into view the entire course of the optic nerve (2) around the crus cerebri. F. Part of the tuber cinereum. G, G. The corpora albicantia. H. The locus perforatus. I. The right half of the pons Varolii. K. The crus cerebelli of the right side. L. The medulla oblongata. M, M. The corpora pyramidalia. N, N. The corpora olivaria. O, O. The corpora restiformia. P. The right lobe of the cerebellum. Q. The flocculus or pneumogastric lobe of the cerebellum. R. The inferior vermiform process. S. The left lobe of the cerebellum divided by a longitudinal incision through its outer third. T. The ascending fibres of the corpus restiforme expanding into the cerebellum, and surrounding the corpus rhomboideum, U, or ganglion of the cerebellum. V. The superior converging fibres of the pons Varolii, forming the crus cerebelli. W. The diverging fibres of the corpus pyramidale, expanding in the grey substance of the pons Varolii. X. The passage of the diverging fibres through the crus cerebri. Y. The admixture of the diverging fibres with the grey substance of the thalamus opticus, or inferior ganglion of the cerebrum. Z. The admixture of the diverging fibres with the grey substance of the corpus striatum, or superior ganglion of the cerebrum.

a, a. The expansion of the diverging fibres into the convolutions of the left hemisphere. b, b. The divergence and expansion of the primitive fibres of the corpora olivaria through the ganglia of the cerebrum into the left hemisphere, principally its posterior lobe. c. The anterior commissure of the third ventricle, consisting of converging fibres connecting the corpora striata. d. The band of white fibres reflected from the corpus mamillare into the thalamus opticus.

1. The olfactory nerve (n. olfactorius).

e. Its inner root. f. The expansion of its external root.

2. The optic nerve (n. opticus).

3. The third nerve (n. motorius oculi).

4. The fourth nerve (n. patheticus).

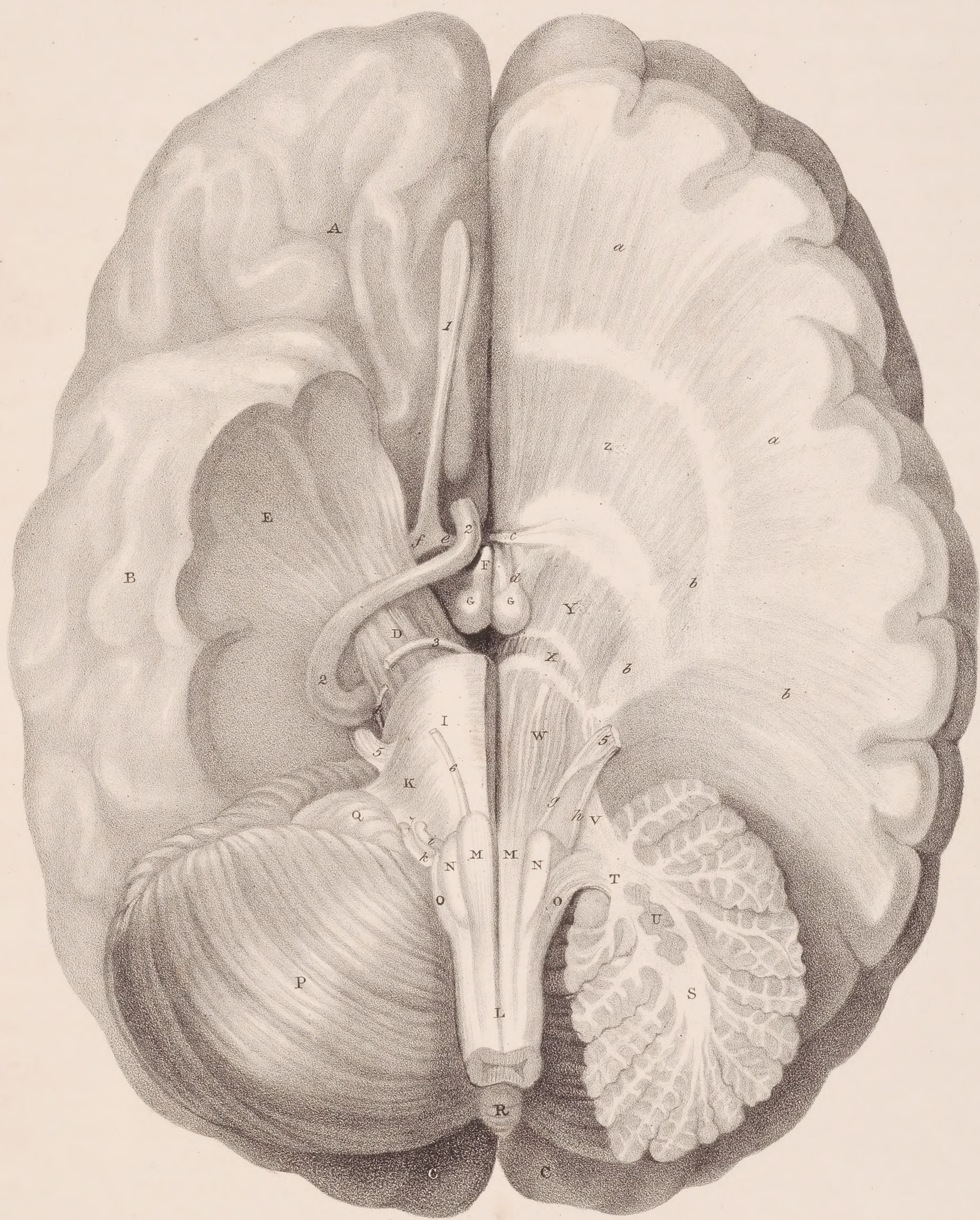
5, 5. The fifth nerve (n. trigeminus). On the left side it is traced to its origin by two roots : one, g, the anterior root, is continuous with the diverging fibres of the corpus pyramidale ; the other, h, the posterior root, passes forwards from the corpus restiforme.

6. The sixth nerve (n. abducens).

7. The seventh pair of nerves.

i. The portio dura. k. The portio mollis.

Plate 10.



WJE Wilson delinavit

Drawn from Nature by W. Bagg.

W^m Fairland lith

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Plate II.

Fig 1.



Fig 2.



W.E. Wilson, directr.

Drawn from Nature by W. Bagg.

Wm. Fairland, lithog.

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Vessels.—The brain is supplied with blood by the two internal carotid arteries, and the two vertebral; its residual blood is returned by the two internal jugular veins.

OF THE CEREBRAL NERVES.

Olfactory nerve (plate VIII. 1; plate XI.; nervus olfactorius, par primum).—The olfactory, or, as it is frequently called, the first pair of nerves, lies in a longitudinal groove marked on the under surface of the anterior lobe of the brain, about half an inch exterior to the median fissure; when undisturbed it appears flat, but is really triangular in form, the upper angle being lodged in the groove just alluded to. The nerve is soft in its texture, not being invested by a membranous tube or neurilema; but the arachnoid membrane is stretched across its inferior surface, and so retains it *in situ*. The nerve arises by three roots, two of which are medullary, the third or intermediate one being cineritious. The external root (r) is the longest, and may be traced in the form of a white line obliquely outwards along the border of the fissure of Sylvius, where it corresponds with the last convolution of the anterior lobe of the brain. The internal root (s), shorter and broader than the preceding, arises, at the inner termination of the fissure of Sylvius, from the substantia perforata (d). By turning down the nerve from the groove in which it is lodged, we see the third origin, which is a delicate line of grey matter, derived from a papilla at the posterior extremity of the sulcus, or groove, just referred to. The first and second roots converge to the third, and the nerve thus formed passes forwards by the side of the crista galli, where it expands into an elongated bulb (plate VIII. b; plate XI. A, A: *bulbus olfactorius*). From the under surface of this structure numerous filaments descend through the cribriform lamella of the ethmoid bone, each of which is invested by a tubular prolongation of the dura mater, and also by one from the arachnoid membrane, which latter, after descending a little way, re-ascends, and becomes continuous with the serous lining of the dura mater. The filaments of the olfactory nerve are arranged into three sets—the internal set (plate XI. fig. 2, C, C) are lodged for awhile in grooves upon the surface of the septum nasi, but soon ramify in the pituitary membrane;

PLATE XI.

The distribution of the olfactory, or first pair of cerebral nerves (nervus olfactorius).

Fig. 1. The distribution of the filaments of the olfactory, sphenopalatine, and fifth nerves, to the mucous lining of the external wall of the right nostril. This view is effected by making a vertical section of the head, parallel with and a little to the side of the septum narium.

No. 1. The cavity of the frontal sinus. 2. The nasal spine of the frontal bone. 3. The right nasal bone. 4. The root of the crista galli. 5. The roof of the right orbit. 6. The anterior clinoid process of the sphenoid bone. 7. The concavity of the sella Turcica. 8. The posterior clinoid process. 9. The sphenoidal sinus. 10. The basilar process of the occipital bone. 11. The petrous portion of the temporal bone. 12. The anterior condyloid foramen of the occipital bone. 13. The right condyle of the occipital bone. 14. The inner aspect of the mastoid process. 15. The styloid process of the temporal bone. 16. The opening of the Eustachian tube. 17. The external pterygoid plate of the sphenoid. 18. The projection of the superior spongy bone, arching over the superior meatus. 19. Projection of the middle spongy bone, arching over the middle meatus. 20. Projection of the inferior spongy bone, arching over the inferior meatus. 21. Section of the soft parts of the nose. 22. Section of the upper lip. 23, 23. Section of the hard palate. 24. The naso-palatine canal. 25. Section of the uvula.

A. The bulb of the olfactory nerve. B. The three roots by which it arises from the brain. C, C. The distribution of its filaments to the mucous membrane covering the superior and middle turbinate bones. D. A twig from the nasal branch of the ophthalmic division of the fifth nerve. E. The sphenopalatine nerves, or nasal branches of Meckel's ganglion, entering the nasal fossa through the sphenopalatine foramen.

Fig. 2. Shows the distribution of the same nerves upon the osseous surface of the mucous membrane lining the septum narium. The section has been made through the left nostril close to the middle line, and the septum has been broken and torn from the membrane, so as to leave it without other support than its attachments to the roof and floor of the nasal fossa.

The points of reference are nearly the same as in the preceding figure; the same numbers, therefore, apply to both, with the few following additions to this figure:

No. 1. The crista galli. 2, 2. The mucous membrane of the right surface of the septum. 3, 3. The broken edge of the septum narium, the remaining portion being removed. 4. The posterior opening of the right nostril. 5. The opening of the right Eustachian tube. 6. The cavity of the pharynx. 7. The right arch of the soft palate.

A. The bulb of the right olfactory nerve. B. Its three roots. C, C. Disposition of its filaments upon the osseous surface of the mucous membrane. D. The nasal nerve; a branch of the ophthalmic division of the fifth pair of nerves. E. Sphenopalatine nerves, distributed to the mucous membrane of the septum. F. The long sphenopalatine nerve, entering the naso-palatine canal to join the naso-palatine ganglion. G, H. Anterior palatine nerves. I. Posterior palatine nerves from Meckel's ganglion.

the external set (fig. 1, C, C) descend upon the two superior turbinated bones, and upon the plain surface before them; but the middle ones are short, and confined to the roof of the nares. We speak of the "origin" of this nerve from the brain, and we indicate its "roots" as if it commenced there and terminated in the nose. But all that we know of its developement and of its function shows the reverse to be the fact. As it is a nerve of simple sensation, and as impressions are conveyed by it in one direction only, viz. from without inwards, it would be better to consider the so-called roots as its points of attachment and connexion with the brain.

Though the whole of this tract is considered a nerve, the term in strictness applies only to the filaments which pass down into the nose from the bulb; the rest, or cranial part, appearing to be a prolongation of the cerebral substance itself,—of the grey as well as the white, which does not occur in the nerves. In fishes it obviously is a prolongation from the olfactory lobe—a continuation of its proper substance, and even in some cases the two olfactory nerves are connected by a transverse fasciculus like a commissure. It was usual to say that the external root of the nerve was connected with the under surface of the corpus striatum; but no relation exists between this body and the nerve.* For though the latter is fairly developed in reptiles, the former is atrophied; and again, the corpus striatum exists in cetaceous mammalia, though, according to Cuvier, the olfactory nerve does not exist in them—or, at all events, is reduced to the minimum of size of which it is capable.

Optic nerve (plate VIII. 2; plate XII. fig. 1, 2, 2: *nervus opticus, par secundum*).—The optic nerves present several striking peculiarities. They are united by a commissure, are of considerable size, but give off no branches; and their length within the skull is greater than that exterior to it. Each optic nerve arises not from the optic thalamus, but from the corpus geniculatum externum (plate XII. a, a), and from a white fasciculus (b, b) sent downwards from the nates; or rather these are the points by which it is attached to the cerebral substance, and to which it conveys its impressions. The nerve, at first soft and flat, rests on the crus cerebri, and passes forwards, converging to its fellow of the opposite side, with which it unites before the pituitary fossa, and between the anterior clinoid processes. From the commissure (c) each of the nerves proceeds forwards and outwards through the foramen opticum, where it is surrounded by the recti muscles; and having reached the posterior surface of the globe of the eye, pierces the sclerotic coat, after which it passes through the choroid, and finally becomes continuous with the retina.

The Optic commissure: its structure.—A considerable difference of opinion exists concerning the disposition of the fibrillæ of the optic nerves at their commissure. Some of the earlier anatomists supposed that they were merely applied one to the other, without any actual admixture of their substance; this opinion has now no supporters. Several physiologists are of opinion that a decussation between the nerves of opposite sides takes place, the fibres of that on the right side passing to the left, and *vice versâ*. Others, on the contrary, contend that the decussation, or crossing, exists only to a certain extent, being confined to the fibres on the inner side of each nerve, the rest passing on uninterruptedly. The anatomical examination of the fibrillæ, after the nerves have been macerated in dilute nitric acid, seems to indicate that those on the external border of each of them proceed forwards without admixture, but that several pass obliquely inwards through the commissure, and afterwards form part of the fibres which proceed to the eye of the opposite side: this at least is the result of Caldani's observations. Little account can be made of conclusions deduced from experiments on animals; the quantity of injury inflicted by opening the skull, in order to divide the nerves or their commissure, is sufficient to confound all the sensations of the animal, and render any inferences nugatory that may be drawn from them. Observations on the morbid conditions of the nerves have been adduced in support of both opinions: thus, in a case in which the right eye had been destroyed, the optic nerve was found altered and wasted back to the commissure on that side, and thence to the brain at the opposite side; thus supporting the theory of decussation. Some cases have also occurred in which blindness of one eye was traced to a morbid alteration of the nerve of the opposite side, at its origin from the brain. Some other instances, however, would go to prove that the decussation is only partial. In one instance in which the eye had been destroyed, and its nerve altered in texture for some way, it was found that the external fibres of the diseased nerve could be traced from the commissure directly backwards to the brain at the same side, so could the external fibres of the sound nerve; thus showing that no decussation took place between them; but the internal fibres of the diseased nerve could be traced obliquely through the commissure, and also backwards along the inner side of the opposite nerve to its origin, whilst the inner fibres of the sound nerve seemed, but not so distinctly, to cross also to the opposite side. Each of these opposing opinions, then, is borne out by

* Serres, vol. i. p. 290.

the observations to a certain extent; so that the advocates of them are not warranted in concluding that either is universally true. Professor Meckel supposes that the anterior or orbital parts of the nerves issue from a common point (the commissure), produced by a union of the fibres which are prolonged from the brain, and that the mode of union is not quite identical in all cases, for that, in the different other structures which are joined along the middle line, varieties in the manner and degree of their union are constantly observed to occur.

Otto* remarks, that in cyclopic monsters, and in hemicephalic cases, the optic nerves have been seen to run apart and without a commissure; and that in dropsy of the brain the commissure has been observed torn asunder, and, instead of crossing, only connected by a transverse portion of nerve.

Auditory nerve (plate VIII. x; plate XII. fig. 2, c: *nervus auditorius, portio mollis paris septimi*).—The auditory nerve is usually, since the time of Willis, called “the soft portion” of the seventh cerebral nerve. The use of such a name confounds all distinctions of structure, function, place of origin, and mode of termination; in each of which particulars these nerves differ from one another. One of them is subservient to a special sense—that of hearing, and is susceptible of no impression except that of sound; the other is altogether a nerve of motion, and has little, if any, sensibility. The auditory nerve is nearly as soft as the olfactory; the facial is a firm cord, like the motor oculi nerve. Now, as to origin, the facial arises from the groove between the corpus olivare and pyramidale, and forms the first of a series, which are associated at their place of origin, and combine in some remarkable particulars of function; viz. the glosso-pharyngeal, pneumo-gastric, and spinal accessory nerves: with these the auditory nerve obviously has nothing to do; for, to give an abridged expression of its commencement and termination, it extends from the floor of the fourth ventricle to the meatus auditorius internus, through which it is conducted into the internal ear. In this course it is not in connexion, but merely in apposition with the facial nerve, which lies internal and anterior to it, and even compresses its surface so as to mark it by a slight groove. But what is its proper origin? It has been usual for a long time (ever since Piccolomini pointed out a connexion between it and certain white striæ or lines traced upon the posterior surface of the restiform bodies) to say that this nerve arises from the floor (d) of the fourth ventricle, by some white fibres which lie obliquely upon it. This sufficiently indicates the place; but as to the mode of the connexion, that is another question. Wenzel showed that the fibres of the auditory nerve are traceable to the “loculus cœruleus” in the floor of the fourth ventricle. Serres calls it “ruban gris” when much developed; and, as the general result of his researches, says, that in all the mammiferous animals which he has examined, he found the nerve connected with the lateral parts of the medulla by two sets of fibres, of which the posterior one is attached to the side of the fourth ventricle, the “ruban gris” being in intimate connexion with it, whilst the anterior fasciculus is fixed to the extremity of the trapezium. Now the trapezium is a flat, narrow band of white fibres, extended transversely behind the pons, and before the olivary bodies. It is readily distinguishable from the pons, for the latter is continuous with the crura cerebelli, whilst the band here alluded to commences in the fourth ventricle.

It may perhaps appear an unnecessary refinement to say, as M. Serres does, that though the nerve is connected to the points here indicated, it still does not arise from them; for that it is but substituting the word “insertion” for “origin,” leaving the facts to stand as before. It is sufficiently known that this nerve, as well as all others, is produced and grows independently of the brain and cord; that they are deposited by their own nutrient vessels, each in its proper place, and that their progress is from without inwards; consequently they do not “arise” from the brain in the same sense as plants arise from their roots. Now, when the auditory nerve grows inwards and comes into contact with the side of the ventricle, it contracts a union with it, which may be called organic, as the two structures are intimately blended. The white striæ are developed subsequently, and so also is the grey matter, the “ruban gris.”

As the auditory nerve inclines outwards to gain the meatus internus, it is, as has been above stated, in close contact with the facial nerve, from which it is separated by a small arterial branch derived from the basilar, or anterior cerebelli artery that accompanies it into the meatus. The distribution of the nerve shall be indicated when treating of the anatomy of the ear.

Third cerebral nerve (plate VIII. 3; plate XIII. III.: *nervus motorius oculi, motores oculorum, par tertium*).—This nerve, which is the third in order when they are counted from before backwards, arises from the inner border of the crus cerebri, about two lines anterior to the pons Varolii. This is only the point at which the nerve issues from the cerebral substance, and becomes invested by its neurilema and a tubular sheath of arachnoid membrane, for its fibrillæ can be traced backwards into

* South's edition, p. 448.

the grey substance within the cerebral protuberance, if the pons Varolii be removed. The nerve passes forwards, and a little outwards, to enter a canal appropriated to it in the dura mater, close by the posterior clinoid process, at which point its serous investment leaves it, and becomes continuous with that which lines the dura mater. As the nerve proceeds forwards, it lies along the external wall of the cavernous sinus, being at first placed superior and internal to the fourth, the ophthalmic branch of the fifth and the sixth nerves; as it approaches the sphenoidal fissure, it descends so as to become inferior to the other nerves, and divides into two branches, which separately pierce the dura mater, and enter the orbit by passing between the heads of the external rectus muscle. The superior or smaller branch (plate XIII. a) ascends so as to get above the optic nerve, and gives one or two ramusculi to the superior rectus muscle, the other being prolonged to the levator palpebræ: the inferior or larger branch (b) lies beneath, and to the outside of the optic nerve, where it divides into three branches, one of which passes obliquely inwards to the rectus internus muscle; another descends and is distributed to the rectus inferior; whilst the third, longer than either, passes forwards between the inferior and external recti muscles, and terminates in the obliquus inferior: these several nerves enter the muscles at the surface which looks towards the eye-ball. The branch last described gives off a filament (c), which enters the inferior and posterior angle of the lenticular ganglion.

Fourth nerve (plate VIII. 4; plate XII. figs. 1 and 2, 4; plate XIII. IV.: nervus trochlearis, nervus

PLATE XII.

The origin and distribution of the optic and auditory nerves.

Fig. 1. The origin of the second pair of cerebral nerves, or optic (nervi optici). The hemispheres of the cerebrum and cerebellum, and the corpora striata, have been removed, so as to leave only the thalami optici, and their communications with the medulla oblongata.

A. The medulla oblongata. B, B. The corpora pyramidalia. C. Decussation of the corpora pyramidalia. D, D. The corpora olivaria. E, E. The corpora restiformia. F. The pons Varolii. G, G. Division of the transverse fibres of the pons Varolii, to give passage to the fifth nerve. H, H. The crura cerebri. I. The locus perforatus. K. The corpora mammillaria. L. The tuber cinereum, with part of the infundibulum. M, M. The thalami optici.

No. 2, 2. The optic nerves.

a, a. The origin of the optic nerve from the corpus geniculatum externum. b, b. The fasciculus sent down from the nates. c. The commissure of the optic nerves. d, d. The constriction of the optic nerve, opposite its entrance into the sclerotic coat. e. The sclerotic coat of the eye. f. The cornea. g. The retina of the eye. h. The zonula ciliaris. i. The lens.

3, 3. The third pair of nerves (n. motores oculorum).

4, 4. The fourth pair (n. pathetici).

5, 5. The fifth pair (n. trigemini; trifacial).

6, 6. The sixth pair (n. abducentes).

7, 7. The seventh pair.

k. The portio mollis (n. auditorius). l. The portio dura (n. facialis). m. The portio minor (vel intermedia) of the facial nerve.

8, 8. Part of the eighth pair.

n. The glosso-pharyngeal nerve. o. The pneumo-gastric nerve (par vagum).

9, 9. The ninth pair (n. hypo-glossus).

Fig. 2. The origin and distribution of the auditory nerve (nervus auditorius; portio mollis septimi paris). The preparation of the brain is the same as in the preceding figure, but seen from the side. The labyrinth of the ear, to which this nerve is distributed, is somewhat magnified.

A. The medulla oblongata. B. The right corpus pyramidale. C. The corpus olivare. D. The corpus restiforme. E. The pons Varolii. F. Section of the crus cerebelli of the right side. G. The right crus cerebri. H. Tuber cinereum, with part of the infundibulum. I, I. Processus è cerebello ad testes. K. The nates. L. The testes. M. The pineal gland. N. Lateral section of the thalamus opticus.

No. 2. The commissure of the optic nerves.

3. The third nerve.

4. The fourth nerve, traced backwards to its origin.

5. The fifth nerve.

6. The sixth nerve.

7. The seventh pair.

a. The portio dura. b. The portio minor of the facial nerve. c. The portio mollis, or auditory nerve. d. The origin of the auditory nerve from the floor of the fourth ventricle. e. The division of the nerve into a branch for the cochlea, and two for the vestibule. f. The expansion of the auditory nerve within the canals of the cochlea. g. The vestibular branch to the ampulla, h, of the superior semicircular canal. i. The third branch of the auditory nerve expanding into the sacculus vestibuli, k. l. The ampulla of the posterior semicircular canal. m. The nervous lining of the superior semicircular canal. n. The nervous lining of the posterior semicircular canal. o. The inferior semicircular canal.

Plate 12.

Fig 1.

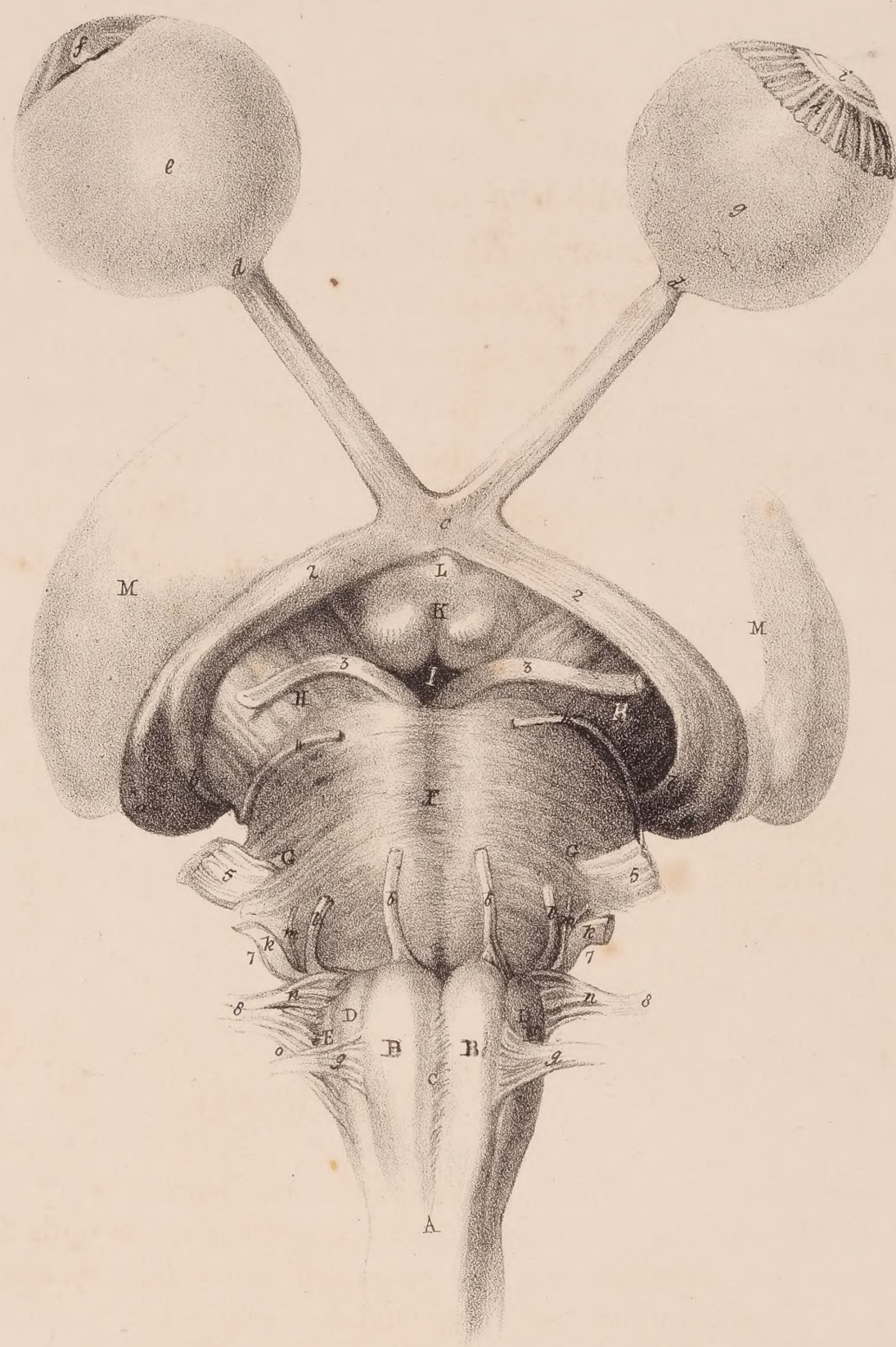


Fig 2.



Plate 13.

Fig. 1.

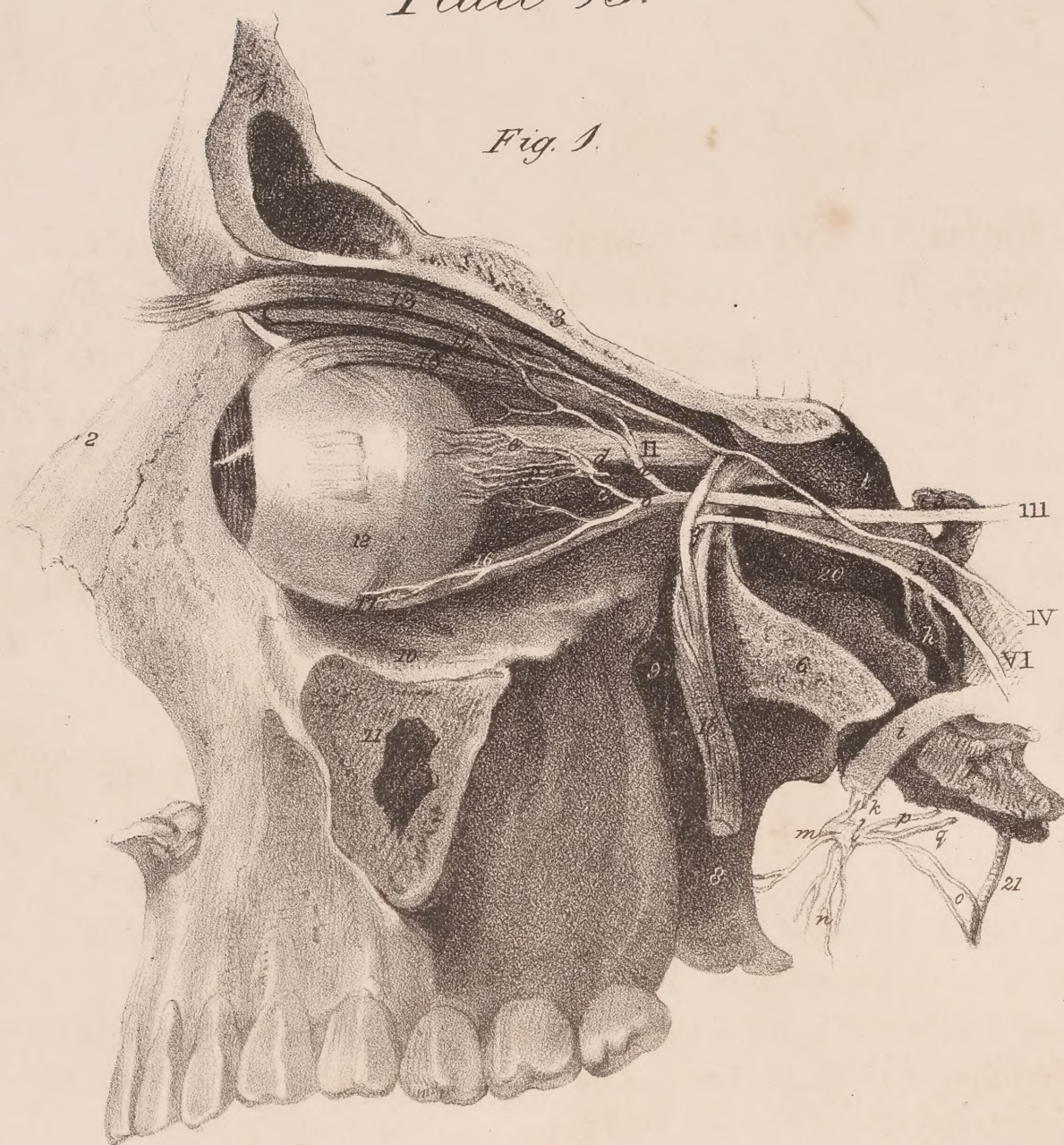
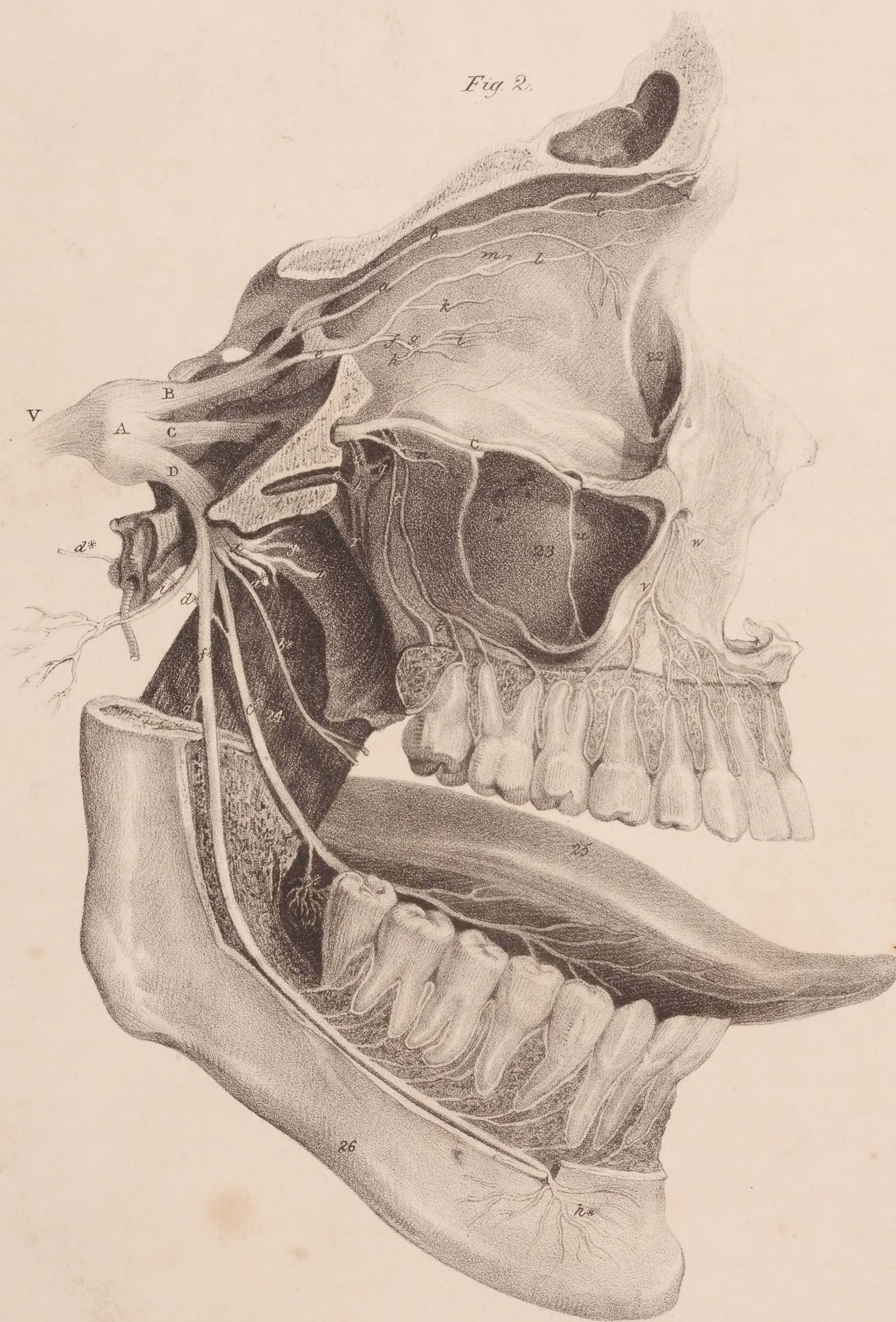


Fig. 2.



patheticus, par quartum).—This is called the fourth, though it does not range in line with the others. It is the smallest of the cerebral nerves: it arises by two, and sometimes by three filaments, from the valve of Vieussens, immediately beneath the tubercula quadrigemina. Each nerve (plate XIII. IV.) passes forwards on the side of the cerebral protuberance, on a level with the margin of the tentorium cerebelli, and enters an aperture in the dura mater, a little inferior and external to that of the third pair: by this it is conducted into the cavernous sinus, along whose external wall it runs towards the sphenoidal fissure, through which it enters the orbit, at the same time passing above the third nerve. The nerve finally inclines upwards and inwards, mounting over the superior rectus

PLATE XIII.

Fig. 1. The nerves of the orbit, with the ophthalmic and otic ganglia, are here shown. This view has been procured by removing the upper and outer wall of the orbit.

No. 1. The section of the frontal bone, showing the cavity of the frontal sinus. 2. Nasal bone of the left side. 3. Section of the upper wall of the orbit. 4. The anterior clinoid process. 5. The posterior clinoid process. 6. Section of the greater ala of the sphenoid bone. 7. The spinous process of the sphenoid bone. 8. The pterygoid process. 9. The pterygo-maxillary fossa. 10. The floor of the orbit. 11. Section of the superior maxillary bone, showing the cavity of the antrum maxillare. 12. The globe of the eye. 13. The levator palpebræ superioris muscle. 14. The superior oblique muscle. 15. The superior rectus muscle. 16. The inferior rectus. 17. Part of the inferior oblique muscle. 18. The external rectus muscle, divided and turned down. 19. The internal carotid artery. 20. The depression for the cavernous sinus. 21. The arteria meningea media, entering the spinous foramen in the sphenoid bone.

II. The optic nerve.

III. The third nerve (n. motorius oculi).

a. The superior branch of the third nerve. b. Its inferior branch. c. The branch to the ophthalmic ganglion. d. The ophthalmic or lenticular ganglion. e. The upper fasciculus of ciliary nerves. f. The lower fasciculus.

IV. The fourth nerve (n. trochlearis patheticus).

VI. The sixth nerve (n. abducens).

g. The passage of the sixth nerve between the two heads of the external rectus muscle. h. Filaments of communication from the superior cervical ganglion of the sympathetic to the sixth nerve. i. The trunk of the inferior maxillary nerve. k. Its motor root. l. The otic ganglion (ganglion oticum vel auriculare). m. The internal pterygoid nerve, piercing the otic ganglion. n. Filaments of communication with the auricular nerve. o. Nervi molles to the otic ganglion from the superior cervical ganglion of the sympathetic, accompanying the middle meningeal artery. p. Filament to the tensor tympani muscle. q. Communicating filaments between the otic ganglion and the nervus tympanicus; a branch of the glosso-pharyngeal nerve.

Fig. 2. The fifth nerve (n. trigeminus), with its branches. This dissection has been made by dividing the bones nearer to the middle line than in fig. 1. The ramus of the inferior maxillary bone has been sawn across, and the external wall of the bone and alveolar process chiselled away, both in the upper and lower maxillæ, to bring into view the branches of the dental nerves, which are distributed to the teeth. The numeral references are the same as in fig. 1.

No. 22. The depression in the lachrymal bone for the lachrymal sac. 23. The inner wall of the antrum maxillare. 24. The internal pterygoid muscle. 25. The tongue. 26. The inferior maxillary bone.

V. The fifth nerve (n. trigeminus).

A. The Casserian ganglion. B. The ophthalmic nerve (n. ophthalmicus).

a. The lachrymal nerve (n. lachrymalis). b. The frontal nerve (n. frontalis). c. Its supra-trochlear branch (n. supra-trochlearis). d. Its supra-orbital branch (n. supra-orbitalis). e. The nasal nerve (n. oculo-nasalis). f. Branch to the ophthalmic ganglion (ramus ad ganglion). g. The ophthalmic ganglion. h. Its branch to the inferior division of the third nerve. i. Its ciliary branches. k. Ciliary branch of the nasal to the globe of the eye. l. Infra-trochlear branch of the nasal nerve. m. The continuation of the nasal nerve through the anterior ethmoidal foramen into the nose (n. nasalis internus vel ethmoidalis).

C. The superior maxillary nerve (n. maxillaris superior).

n. Its orbital branch (n. subcutaneus malæ). o. Branches of communication from Meckel's ganglion. p. Meckel's ganglion. q. Spheno-palatine branches of Meckel's ganglion. r. Palatine nerves. s. The Vidian nerve: the bone is removed so as to show this nerve in its passage through the Vidian or pterygoid canal. t. Posterior dental branches of the superior maxillary nerve. u. A dental nerve given off from the superior maxillary while in its canal, and passing between the mucous membrane and outer wall of the antrum to supply the teeth. v. Anterior dental branch. w. Terminal branches of the superior maxillary, distributed to the face.

D. The inferior maxillary nerve (n. infra-maxillaris).

x. The muscular division of the nerve. y. The deep temporal branches (n. temporales profundi). z. The masseteric branch (n. massetericus). a*. The external pterygoid branch (n. pterygoideus externus). b*. The buccal branch (n. buccalis). c*. The gustatory nerve (n. gustatorius vel lingualis). d*. The chorda tympani nerve. e*. The submaxillary ganglion. f*. The inferior dental nerve (n. dentalis). g*. Its mylo-hyoidean branch (n. mylo-hyoideus). h*. The mental nerve (n. mentalis). i*. The auricular nerve (n. temporalis superficialis), embracing the arteria meningea media.

muscle and the levator palpebræ, and divides into two or three filaments, which enter the superior oblique muscle at its orbital surface. Whilst the nerve lies along the external wall of the cavernous sinus a small filament passes off from it, and is reflected back in the tentorium cerebelli as far as the lateral sinus.

Sixth nerve (plate VIII. 6; plate XII. fig. 1, 6: nervus abducens; par sextum).—This nerve arises, close by the central line, from the superior extremity of the corpus pyramidale, where it joins with the pons Varolii. From this point the nerve (plate XIII. fig. 1, VI.) passes forwards and upwards, to enter the cavernous sinus, by a foramen in the dura mater, where it rests against the outer side of the carotid artery, and whilst so placed receives two or three filaments (h) of communication from the superior cervical ganglion, or rather from the carotid plexus. The nerve passes thence forwards to the sphenoidal fissure, separated from the cavity of the cavernous sinus by its lining membrane; and on passing into the orbit runs between the two heads of the external rectus, to which it is distributed by two or three filaments, which pierce the ocular surface of the muscle.

Ninth nerve (plate VIII. 9; plate XII. fig. 1, 9: nervus lingualis, or the ninth pair of nerves; n. hypo-glossus, par nonum).—It arises by several delicate filaments placed in a continued series along the sulcus between the corpus pyramidale and olivare of each side. These filaments converge and unite as they pass forwards to the anterior condyloid foramen, through which the nerve they form makes its exit from the cranium. The nerve (plate XVI.) at first is deeply seated, lying posterior and internal to the sympathetic and vagus nerves, with both of which and the first cervical nerve it communicates; but it gradually comes forwards as it descends, and after passing between the carotid artery and jugular vein, becomes more superficial than either of the nerves just mentioned, and lies a little below the posterior belly of the digastricus muscle. The nerve now inclines forwards and inwards, parallel with the cornu of the os hyoides, gets under cover of the mylo-hyoid muscle, and is separated from the lingual artery by the hyo-glossus muscle, at the inner border of which it ascends somewhat, and divides into several filaments, which are distributed to the genio-hyo-glossus and lingualis muscles.

Ramus descendens noni.—At the point where the nerve makes its turn forwards, it will be observed to hook round the occipital artery, and then, where it crosses over the external carotid artery, to give off its chief branch, the *descendens noni*, which inclines downwards and inwards in front of the sheath that encloses the carotid artery and internal jugular vein, and at the middle of the neck curves outwards to form an inverted arch, by joining with two branches from the cervical plexus of nerves. The convexity of the arch looks downwards, and from it several long delicate filaments are given off, which descend upon the fore part of the neck, and are distributed to the sterno-hyoid and sterno-thyroid muscles, also to the omo-hyoideus. Previously to its ultimate division, the lingual nerve gives some filaments to the hyo-glossus muscle, and others to communicate with the gustatory nerve.

Facial nerve (plate VIII. 7, w: nervus facialis; portio dura pars septimi, sympatheticus minor).—The facial nerve arises from the sulcus between the corpora restiformia and olivaria, close by the lower margin of the pons Varolii, whence it passes forwards and outwards, closely applied to the portio mollis, which is slightly hollowed to receive it, whilst in the meatus it receives some filaments from the auditory nerve. (Cruveilhier.) Having reached the fundus of the meatus auditorius internus, the portio dura enters an osseous tube (*aqueduct of Fallopius*), through which it is conducted, in a curved direction, outwards and backwards, to the stylo-mastoid foramen. After having passed about two lines into the tube just named, a small nerve (*Vidian*) becomes applied to its inferior surface, and accompanies it nearly to the point of its exit from the foramen above mentioned. The Vidian nerve there leaves it, and passes obliquely across the cavity of the tympanum, where it assumes the name of chorda tympani: its course and destination shall be particularly considered when treating of the gangliac system of nerves. While within its osseous canal, the facial nerve gives two small filaments, which enter the cavity of the tympanum, and are distributed to the tensor tympani and stapedius muscles; the former being given off at the commencement, the latter near the termination of this portion of its course.

After having issued from the stylo-mastoid foramen, the nerve (plate XIV. A) sends off three small branches previously to its ultimate division.

The *posterior auricular* branch (a; n. auricularis posterior) inclines backwards and upwards in front of the mastoid process, and subdivides into two branches, one of which ramifies in the occipitalis muscle and the integuments, while the other gives twigs to the retrahens aurem muscle, to the pinna, and to the meatus externus. The *stylo-hyoid branch* (b; n. stylo-hyoideus) descends upon the stylo-

hyoideus muscle, to which, and to the digastricus, it is partly distributed, the remainder of its filaments maintaining communication with the sympathetic nerve and the ascending branch of the cervical plexus. The *digastric branch* (ramus digastricus) inclines outwards to the posterior belly of the digastric muscle, to which it distributes the greater number of its filaments, the remainder maintaining communications with the nerves emerging from the foramen lacerum, in front of the internal jugular vein.

The facial nerve, after giving off these branches, inclines forwards beneath the external meatus to the ramus of the inferior maxilla, lying deeply imbedded in the substance of the parotid gland. Here it divides into two primary branches, which have been named from their destination temporo-facial and cervico-facial; sometimes as many as four, or even five, exist; these communicating one with another form a sort of plexus (c; plexus parotideus, pes anserinus), from which numerous branches are distributed to the temples, the face, and the neck. The branches from the plexus, formed as above, may be divided into three sets, differing in destination and direction.

The first ascend upon the zygoma in front of the ear (d, d; rami temporales), accompanying the temporal artery and its branches even to the summit of the head, supplying filaments to the integuments, and the several muscles, namely, those of the pinna, the frontal part of the occipito-frontalis, and orbicularis palpebrarum. They communicate with the terminal branches of the occipital nerves (s), and upon the forehead, eyebrow, and upper lid, they interlace with the frontal nerves (g). The second set consists of branches which pass transversely upon the cheek and side of the face (e, e; rami malares), ramifying upon the lower eye-lid, the side of the nose, and the lips, where filaments are furnished to the muscles, and interlace with those of the superior maxillary branch of the fifth nerve (i): one of these usually runs between the parotid duct and the transversalis faciei artery. These two sets of branches were combined by Chaussier under the denomination temporo-facial. The third or descending branches (f, f; cervico-facial, Chaus.) run obliquely over the masseter muscle, inclining towards the base of the jaw-bone, beneath which some of them ramify in the platysma and the integuments, and communicate with the ascending branches (m) of the cervical nerves; but others higher up are distributed in the depressor muscles of the lip, and maintain a similar connexion with the inferior maxillary branch (k) of the fifth nerve, where it ramifies on the chin. Having stated the general plan, according to which the distribution of the facial nerve takes place, it may be observed, that its filaments enter the substance of the muscle of the temple and eye-lids, those of the cheeks, lips, and nose. Now, it will be recollected that these are all supplied with branches from the different divisions of the fifth nerve also, which suggests the question—Do these parts receive merely an additional quantity of the same influence by their double supply of nerves, or do they derive from these sources an influence differing not in degree, but in kind? The question has been decided by direct experiment. If the seventh nerve be divided, the muscles it supplies lose the power of motion, but retain their sensibility; but if the fifth nerve be cut across, motion is retained, though the sensibility is lost.

Glosso-pharyngeal nerve (plate XV.; nervus glosso-pharyngeus) is a small nerve placed at its origin between the facial and the vagus nerve, its root being implanted by separate filaments into the groove between the corpus olivare and restiforme. The nerve inclines outwards and forwards to the foramen lacerum posterius, where it enters a small canal formed for it by the dura mater, through which it escapes from the skull. In its transit it lies internal and anterior to the jugular vein:—while in the canal it presents a slight gangliform swelling (ganglion petrosum); below the ganglion it descends almost vertically before the internal carotid artery, and between the stylo-glossus and stylo-pharyngeus muscles. It then curves forwards to reach the dorsum of the tongue. It gives several branches as follows:

The *tympanic branch* (ramus tympanicus, v. Jacobsoni) arises from the ganglion, and enters a canal in the bone appropriated to it. The orifice of the osseous canal is seen in the jugular fossa, from which it inclines upwards, and penetrates the inner wall of the tympanum. From this, three canals, still more minute, branch off: one inclines downwards to the carotid canal; a second forwards and upwards to the hiatus Fallopii; a third directly upwards behind the fenestra ovalis, to reach the upper surface of the bone, where it terminates in a groove internal to the hiatus Fallopii. Now, the nerve emerging from the ganglion enters the canal, and divides into three branches corresponding with those just indicated as existing in the bone. One descends to join the carotid plexus; of the others, one joins with the Vidian nerve in the hiatus, and the third terminates in the otic gan-

* Exposition of the Nervous System, by C. Bell.

gion. Arnold, in his seventh plate, figures two other filaments; one going to the foramen rotundum, the other to the foramen ovale.

A branch passes off from the ganglion, and inclines downwards and outwards for a little way behind the styloid process; after which it curves up to join the portio dura, or facial nerve, as it issues from the stylo-mastoid foramen. This is the *ramus anastomoticus* ad nervum facialem. Another proceeds to the vagus and spinal accessory. Two or three descend upon the carotid artery, and join the nervous plexus upon it. A muscular branch is given off from the outer side of the nerve, which divides into two: one to the posterior belly of the digastric muscle—*ramus digastricus*, the other to the stylo-hyoid—*ramus stylo-hyoideus*. The pharyngeal branches are two or three which incline inwards, and ramify upon the superior and middle constrictors, contributing to form the pharyngeal plexus. Where the nerve lies close to the tonsil, it gives off some filaments which spread upon it as a plexus—*rami tonsillares*. Finally, on reaching the root of the tongue, the terminal branches of the nerves pass forwards, approaching the mucous membrane, to which and the follicles they seem to be distributed.

Pneumo-gastric nerve (plate XV.: nervus pneumo-gastricus; n. vagus; par vagum, sympathicus medius, pneumo-gastrique) arises immediately beneath the preceding, by eight or ten filaments placed closely together, so as to form a flat fasciculus. The nerve inclines outwards and forwards to the foramen lacerum, through which it escapes from the cranium, being in its passage separated from the jugular vein by a process of membrane or of bone, and from the nerves which take a similar course by a tubular prolongation of the dura mater which invests it. The filaments by which the nerve arises become aggregated together at the foramen, and within it the nerve presents a gangliform enlargement; as it emerges from the foramen, and descends beneath the base of the skull, a close communication by branches is established between it and the glosso-pharyngeal, lingual, and sympathetic nerves. In the same situation, also, it presents an elongated swelling, resembling a ganglion in colour and consistence. Soon after its exit from the skull, the nerve inclines outwards and a little backwards, supported by the rectus capitis anticus major; it assumes a vertical direction, and a fixed position or relation with regard to the cervical vessels; for as it continues its course along the neck, it is enclosed within the sheath of these vessels, lying between the carotid artery and jugular vein, and with them overlaid by the sterno-mastoid muscle. Whilst within the jugular fossa, a branch is given off from the ganglion which lies between the jugular vein and the fore part of the fossa, and passes by a small aperture into a canal that leads to the aqueduct of Fallopius, where it joins the facial nerve. Beneath the base of the skull a branch of communication joins the nerve, derived from the spinal accessory, also from the lingual nerve where the latter is crossing in front of it. Filaments

PLATE XIV.

In this plate the facial nerve is exhibited, together with the terminal branches of the fifth nerve. In the neck, the branches of the cervical plexus and great occipital nerve are seen.

Nos. 1, 1. The occipito-frontalis muscle. 2. The attollens aurem muscle. 3. The retrahens aurem muscle. 4. The orbicularis palpebrarum. 5. The compressor nasi muscle. 6. The levator labii superioris alæque nasi. 7. The levator labii superioris proprius. 8. Part of the levator anguli oris. 9. Zygomaticus minor muscle. 10. Zygomaticus major. 11. Orbicularis oris muscle. 12. Levator labii inferioris muscle. 13. The depressor labii inferioris. 14. The depressor anguli oris. 15. The buccinator muscle. 16. The masseter muscle. 17. The posterior belly of the digastric muscle. 18. Part of the hyo-glossus muscle. 19. The stylo-hyoideus muscle. 20. The pulley of the digastric muscle. 21. The anterior belly of the digastric muscle. 22. The mylo-hyoideus muscle. 23. The sterno-hyoideus muscle. 24. Part of the sterno-thyroideus muscle. 25. The upper portion of the omo-hyoideus muscle. 26. The thyro-hyoideus muscle. 27. The sterno-mastoid muscle. 28. Part of the splenius capitis muscle. 29. Part of the splenius colli. 30. The levator anguli scapulæ muscle. 31. The posterior scalenus muscle. 32. The anterior scalenus. 33. The inferior portion of the omo-hyoideus muscle. 34. The trapezius muscle.

A. The facial nerve (portio dura paris septimi, sympathicus minor).

a. Its posterior auricular branch (n. auricularis posterior). b. The stylo-hyoid branch (n. stylo-hyoideus). c. The pes anserinus (plexus parotideus). d, d. Temporal branches of the facial nerve (rami temporales). e, e. Malar branches. f, f. Cervico-facial branches. g. The supra-orbital nerve, a branch of the frontal division of the ophthalmic. h. A twig from the orbital (n. subcutaneus malæ) branch of the superior maxillary nerve. i. The termination of the superior maxillary nerve upon the face. k. The terminal branches of the inferior dental branch of the inferior maxillary nerve. l. The middle branch of the cervical plexus,—the auricularis magnus nerve. m. The internal branch of the cervical plexus,—superficialis colli nerve. n. The plexus formed between the branches of the superficialis colli nerve and the cervico-facial portion of the facial. o. The posterior branch of the cervical plexus,—occipitalis minor. p, p. Descending branches of the cervical plexus. q, q. The phrenic nerve. r. The nervus accessorius of the eighth pair. s. The posterior or great occipital nerve.

Plate 14.

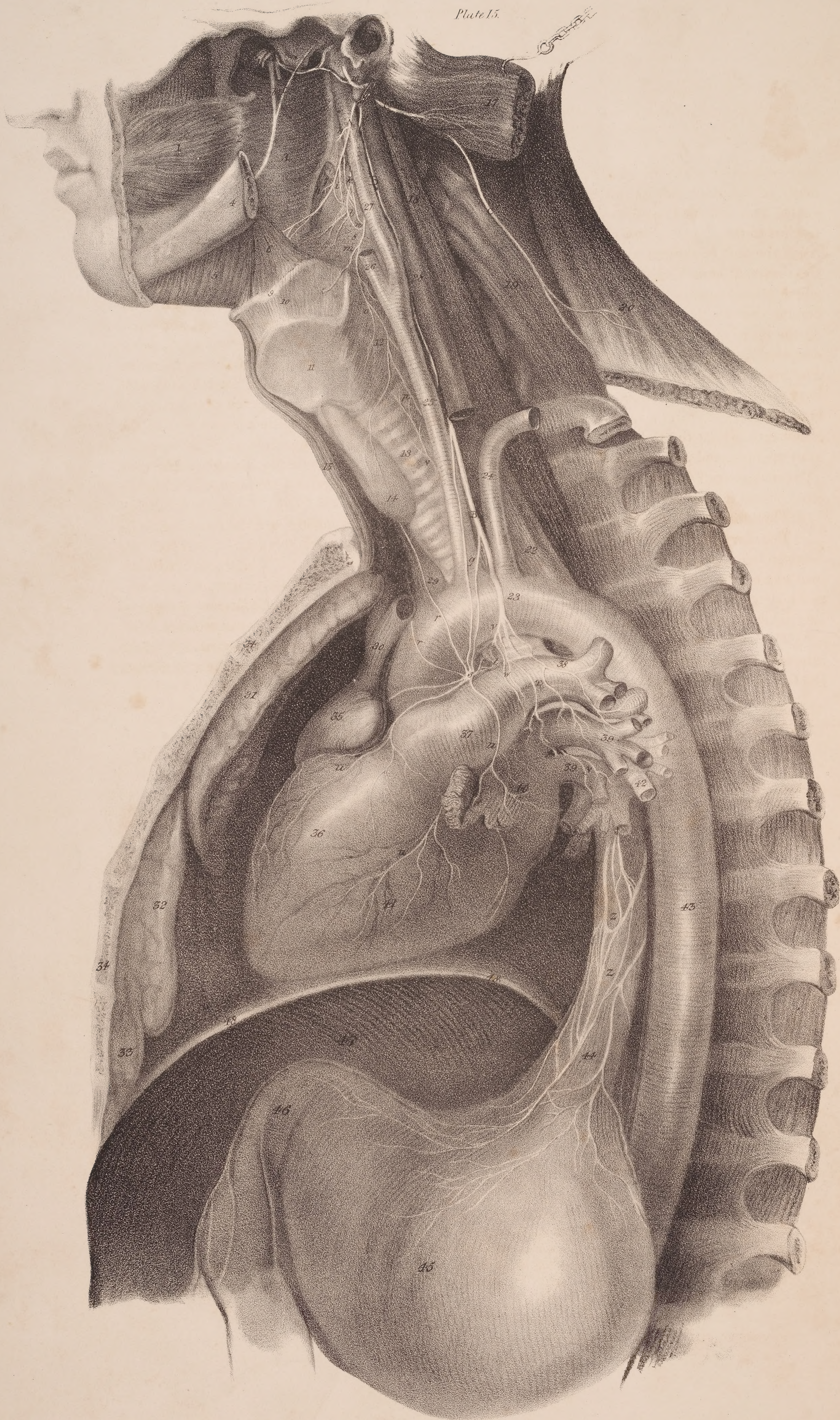


W. J. F. Wilson, Director

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also connect it with the glosso-pharyngeal and the sympathetic. When entering the thorax, the nerve of the right side passes between the subclavian artery and vein, crossing the artery at right angles, and gives off a recurrent branch, which, after turning behind the artery, ascends by the trachea to the larynx. But at the left side the nerve descends parallel with the subclavian artery, to reach the arch of the aorta, round which the recurrent branch takes its course. After having given the recurrent branch, the vagus nerve inclines inwards and backwards, to reach the side of the trachea, where some branches are given off to form a plexus on the anterior aspect of the bronchi, and a considerable number to form another on their posterior surface (*pulmonary plexus, anterior and posterior*). At the lower extremity of the plexus, four or five fasciculi will be observed to pass backwards to the œsophagus, upon which they are prolonged downwards, forming the continuation of the vagus nerve. The branches of both sides are connected by filaments sent obliquely from one to the other, so as to form a sort of mesh. Resting on the œsophagus, and closely connected with it, each of these sets of branches unite to form a single cord, that of the left side inclining somewhat to the fore part of the œsophagus, whilst the right one lies more posteriorly. Both enter the abdomen through the œsophagean opening, and are distributed by numerous filaments to the surfaces of the stomach. The term "pneumo-gastric" is sufficiently expressive of its destination; the lungs and the stomach being the chief organs it supplies.

The branches of the vagus nerve, including those by which it terminates, are the following:

The *pharyngeal* branch (plate XV. k) arises from the vagus nerve immediately after its exit from the foramen lacerum, and inclines downwards and inwards to the side of the pharynx, behind which it divides into two or three filaments, which, conjointly with others derived from the glosso-pharyngeal, the superior laryngeal, and sympathetic nerves, form a plexus (l; *pharyngeal*) behind the middle constrictor muscle; several filaments will be observed to pass from this plexus to the other constrictor muscles also.

The *descending* or *superior laryngeal* nerve (plate XV. m) passes downwards and inwards behind the internal carotid artery, and divides into two branches, both being intended to ramify in the structures of the larynx. The *external* branch (o) passes on the side of the larynx, and gives filaments to the sterno-

PLATE XV.

The distribution of the eighth pair of nerves.

- No. 1. The buccinator muscle. 2. The pterygo-maxillary ligament. 3. The superior constrictor of the pharynx. 4. The body of the lower jaw divided. 5. The mylo-hyoideus muscle. 6. The hyo-glossus muscle. 7. The stylo-pharyngeus muscle divided. 8. The middle constrictor muscle. 9. The great cornu of the os hyoides. 10. The thyro-hyoidean membrane. 11. The thyroid cartilage. 12. The inferior constrictor muscle. 13. The trachea. 14. The thyroid gland. 15. The border of the sterno-hyoid and sterno-thyroid muscles of the right side. 16. The root of the styloid process; the other portion has been removed. 17. The upper part of the sterno-mastoid muscle drawn aside with a hook. 18. The rectus anticus major muscle. 19. The levator anguli scapulæ. 20. The trapezius muscle. 21. The longus colli muscle. 22. The œsophagus. 23. The arch of the aorta. 24. The left subclavian artery. 25. The right carotid artery. 26. The external carotid. 27. The internal carotid artery. 28. The internal jugular vein. 29. The arteria innominata. 30. The superior cava. 31. The superior lobe of the right lung. 32. Its middle lobe. 33. The inferior lobe. 34. Vertical section of the sternum. 35. The right auricle of the heart. 36. The right ventricle. 37. The pulmonary artery. 38. The left pulmonary artery. 39, 39. The left pulmonary veins. 40. The left auricle. 41. The left ventricle. 42. The extremities of the left bronchia. 43. The thoracic aorta. 44. The œsophagus. 45. The stomach. 46. Its pyloric extremity. 47. The under surface of the diaphragm. 48. Its divided edge.
- a. The inferior maxillary nerve. b. The gustatory nerve. c. The chorda tympani nerve. d. The auricular nerve. e. Its communication with the facial nerve (portio dura). f. The facial nerve escaping from the stylo-mastoidean foramen.
- A. The glosso-pharyngeal nerve.
- g. Its communication with the facial nerve. h, h. Branches to the stylo-pharyngeus muscle. i, i. Branches to the pharyngeal plexus.
- B, B. The pneumo-gastric nerve.
- k. The pharyngeal branch, descending to form the pharyngeal plexus. l. The pharyngeal plexus. m. The superior laryngeal branch. n. Branches to the pharyngeal plexus. o. The external branch of the superior laryngeal nerve. p. Its communication with the inferior laryngeal. q. Cardiac branches. r, r. Cardiac branches from the right pneumo-gastric nerve. s. The left cardiac ganglion and plexus. t. The upper extremity of the right cardiac ganglion. u, u. Branches distributed to the heart. v, v. The recurrent or inferior laryngeal nerve. w. Branches sent from the curve of the recurrent nerve to the pulmonary plexus. x. The anterior pulmonary plexus. y. Branches of the posterior pulmonary plexus. z, z. The œsophagean plexus.
- C, C. The spinal accessory nerve (n. accessorius).

thyroid, crico-thyroid, and thyro-hyoid muscles, and to the thyroid gland. The *internal* one pierces the thyro-hyoid membrane, together with the laryngeal artery, and divides into several small filaments, some of which incline upwards to the root of the epiglottis, and ramify on its upper surface, and in the substance of the epiglottic gland: others proceed downwards;—of these, one or two, of very small size, pass through the arytænoid gland, and terminate partly in it, and partly in the mucous membrane; another goes to the arytænoideus muscle; and a third, after communicating with the inferior laryngeal nerve, runs along the groove between the side of the thyroid cartilage and the cricoid, to terminate in the crico-thyroid muscle,—this is a long slender twig.

Below the middle of the neck two or three filaments (plate XV. q, r, r; *cardiac branches*;) are given off, which unite with those of the superficialis cordis (a branch of the great sympathetic,) and from the interlacement formed between them branches are continued down to the arch of the aorta, where they terminate in the cardiac plexus.

The *recurrent* or *inferior laryngeal* nerve runs a very remarkable course; for, as its name implies, after leaving the pneumo-gastric nerve, it turns back into the neck again; but its point of departure, as well as its course and relations, are not the same at both sides. When the pneumo-gastric nerve of the right side is about to descend into the thorax, it passes before the subclavian artery. At that point, the recurrent (plate XVI. r) branch leaves it, and turns round the artery to gain its posterior aspect; after which it inclines obliquely inwards behind the common carotid and inferior thyroid arteries, to reach the side of the larynx. At the left side the nerve descends into the thorax parallel with the subclavian artery, and the recurrent (plate XV. v, v) passes in front of the arch of the aorta and turns behind it, inclining obliquely upwards and inwards, to reach the side of the trachea. Whilst making its turn, the recurrent nerve of each side gives off some filaments (w) to the pulmonary plexus. When arrived at the top of the trachea, the recurrent gives some small filaments to the inferior constrictor of the pharynx, and then enters the cavity of the larynx, where it gives branches to the crico-arytænoid and arytænoid muscles, communicating (p) at the same time with the superior laryngeal nerve. Both these nerves in their course give small branches to the œsophagus and under surface of the trachea; and some also descend in front of that tube, to join the anterior pulmonary plexus.

Bronchial branches.—We may so name several filaments which pass inwards to the bronchus, some anterior to it, but still more behind it. Five or six small branches incline inwards from the nerve, immediately after it has got into the thorax, and, reaching the root of the bronchus, join with the filaments which come down from the recurrent, and form with them the *anterior pulmonary plexus* (plate XV. x). Continuing its course, the nerve sinks backwards, and applies itself to the posterior surface of the bronchus, where it appears at the same time to enlarge and assume the pearly tinge peculiar to the divisions of the sympathetic nerves. It gives off a great number of branches, which form a complex interlacement behind the root of the lung, and hence named *posterior pulmonary plexus* (y). The plexus is further increased by filaments from the third and fourth thoracic ganglion of the sympathetic nerve. Its ramifications take the course of the bronchi through the lungs, even to the air-cells. Those of the anterior pulmonary plexus are similarly disposed. The anterior one, moreover, sends filaments to join with the cardiac plexus.

Esophageal branches.—The nerve, after giving off the pulmonary branches, applies itself to the œsophagus, not, however, as a distinct trunk, but divided into from three to four or five branches; those of the left being anterior, and those of the right rather posterior to the tube; but they communicate by oblique and transverse branches. This interlacement is usually called the *œsophagean plexus* (plate XV. z, z). A little above the diaphragm the branches of the nerve join again, and form at each side of the œsophagus a short single nerve, which enters the abdomen, guided by the tube just named to the stomach.

The terminal branches of the vagus nerves ramify on the stomach. The *left*, on reaching the cardia, spreads out into branches on the anterior surface of the viscus; some of these run along the smaller curvature, where they communicate with those of the right vagus nerve, and finally several filaments are prolonged within the folds of the small omentum, to join with the hepatic plexus. The nerve of the right side, after forming a plexus round the cardia, distributes branches to the posterior surface of the stomach as far as the pylorus, where it communicates with the preceding nerve, and with the coronary plexus formed by the splanchnic nerve; and finally one or two branches pass backwards, leaving the stomach altogether, and join the solar plexus.

Spinal accessory nerve (nervus accessorius).—The *spinal accessory* nerve ascends from the spinal canal into the cranium, and applies itself to the pneumo-gastric nerve—hence its name. It arises by several filaments from the side of the spinal cord, commencing opposite the fourth cervical vertebra.

From this point the nerve ascends to the foramen magnum, lying between the ligamentum dentatum and the posterior roots of the spinal nerves; and, having mounted into the cranium, it comes into contact with the pneumo-gastric nerve, close by which it passes through the foramen lacerum, but in a separate sheath of the dura mater. At the base of the skull this nerve is connected by filaments with the two preceding nerves, as well as with the lingual and sympathetic; after which it inclines outwards and downwards (plate XV. C, C) behind the internal jugular vein, and through the substance of the sterno-mastoid muscle, giving off at the same time several branches for its supply. Having emerged from the muscle at its posterior border, the nerve (plate XIV. r) communicates with those which form the cervical plexus, and then continues its course obliquely downwards and outwards across the neck, until it gets under cover of the trapezius muscle, to which it is finally distributed by several filaments.

The *phrenic nerve* (plate XVI. x; *nervus phrenicus*; *diaphragmaticus*) arises from the lower part of the cervical plexus; its principal root comes from the fourth nerve; one higher up, of smaller size, issues from the third, and usually another from the upper part of the brachial plexus joins it. At first the nerve inclines inwards, descending between the contiguous terminations of the rectus anticus and scalenus anticus muscles, then gets upon the latter, and, so supported, reaches the top of the thorax, which it enters between the subclavian artery and vein, generally crossing the root of the internal mammary artery. It now inclines inwards and somewhat forwards, runs anterior to the root of the lung, insinuates itself between the pleura and the fibrous pericardium, by which it is guided to the diaphragm. Previously to reaching this muscle, the nerve divides into four or five filaments, which pierce its substance, and spread out within it; some of small size also reach its inferior surface, and, guided by the phrenic arteries, join the solar plexus; one or two at the right side pass down with the inferior vena cava.

Fifth cerebral nerve.—We commence the description of the symmetrical nerves which have double roots with that which is commonly called the fifth cerebral nerve.

Nervus trigeminus (nerf trifacial, par quintum).—This nerve in its structure and functions is analogous to the regular or symmetrical nerves. It consists of two parts, derived from distinct sources; one communicating sensation, the other the power of motion; and the former, like the posterior roots of the spinal nerves, forms a ganglion, whilst the latter passes beneath the ganglion, and is unconnected with it, but unites with the third division of the nerve soon after its exit from the skull. The fifth nerve (plate VII. 5.; plate XII. 5.) issues from the cerebral substance about the middle of the crus cerebelli, close to its junction with the pons Varolii. The point here indicated marks the emergence of the nerve from the surface; but the filaments of both roots can be traced deeply; those of the sensitive or larger division can be followed downwards and backwards to the posterior columns of the medulla oblongata, whilst the other can be traced to the motor tract. It consists of from eighty to a hundred filaments, each invested by a neurilema. The filaments at the circumference receive their neurilema sooner than those of the centre, so that if the nerve be torn off, a sort of mammillary process remains, which seems as if it had been concealed in the interior of the nerve. The nerve (plate XIII. fig. 2, V), thus constituted, passes forwards, and on the summit of the pars petrosa pierces the dura mater, and enters a canal formed for it in that membrane. At this point the portion derived from the posterior root alters its appearance; its fibres diverge as they run forwards, and form a compressed plexus of a semi-lunar shape, named *Casserian ganglion* (plate XIII. fig. 2, A). It somewhat resembles a crescent, and from its anterior or convex border three branches are given off, one of which passes into the orbit, another proceeds forwards beneath the orbit to the face, and the third descends through the foramen ovale, to be distributed to the tongue, to the teeth, and to the muscles of the lower jaw. The two former communicate sensibility only to the structures in which they ramify; but the latter gives the power of motion to certain muscles, and sensibility generally to all the organs to which it is distributed; hence it is a compound nerve, and its component parts can at once be recognised by drawing the plexus or ganglion forwards, which will bring into view a nervous cord that lies beneath it on the bone, and which, if traced backwards, will be observed to be continuous with the anterior root of the nerve, and if followed will be found to pass through the foramen, with the third division of the ganglion, and to unite with it immediately after its exit from the skull; the mode of union being perfectly analogous to that of the anterior and posterior roots of the spinal nerves.

Ophthalmic nerve.—The first or ophthalmic branch (plate XIII. fig. 2, B; *ramus quinti paris primus*, v. *ophthalmicus*,) is the smallest of the divisions of the ganglion: it lies beneath and to the outside of the other orbital nerves, and receives, whilst lying along the outer side of the cavernous sinus, some filaments from the sympathetic. It divides into three branches, which separately pierce the dura

mater to enter the orbit through the sphenoidal fissure. These branches, from their destinations, are called lachrymal, frontal, and nasal.

The lachrymal branch, (plate XIII. a; *nervus lachrymalis*;) which is smaller than the others, and also inferior to them, passes forwards between the orbit and the external rectus muscle, to the lachrymal gland, to which it distributes four or five filaments, that enter at its ocular surface; some are also prolonged to the external side of the orbit, and ramify in the orbicular muscle and integument; one or two delicate filaments are also reflected inwards to the upper eye-lid. The lachrymal nerve, near its commencement, receives one or two filaments of communication from the superior maxillary nerve; and, as it proceeds forwards, one or two delicate threads are given off, which pierce the malar bone, and anastomose with the deep temporal branches of the facial nerve.

The frontal branch, (plate XIII. b; *r. frontalis*;) which is the largest offset of the ophthalmic nerve, inclines upwards and inwards, to get between the levator palpebræ and the orbit, being at first closely connected with the fourth nerve. About midway between the summit and base of the orbit, it divides into two branches, one lying internal to the other, but on the same plane; the internal or super-trochlear branch (c; *r. supra-trochlearis*) passes forwards to the point at which the trochlea or pulley of the superior oblique muscle is attached to the margin of the orbit, close to which it emerges on the forehead, lying between the muscles and the bone. It soon, however, pierces the occipito-frontalis, to which it distributes filaments, and ascends upon the forehead and arch of the skull, ramifying freely upon them. The external, or supra-orbital branch (d), passes directly forwards to the supra-orbital notch, through which it escapes on the forehead, its subsequent course and distribution being similar to that of the preceding. These nerves maintain communication with the temporal branches of the facial or portio dura.

The nasal branch (plate XIII. e; *r. oculo-nasalis*;) is intermediate in size and position between the preceding nerves. Having entered the orbit through a separate foramen in the dura mater, it passes between the two heads of the external rectus muscle, and then inclines inwards and forwards, rising

PLATE XVI.

The course and distribution of the ninth or lingual nerve is shown in this figure. The other deep-seated nerves upon the side of the neck are also seen.

No. 1. The mastoid process of the temporal bone. 2. The external auditory process. 3. The styloid process. 4. The glenoid cavity. 5. The zygoma. 6. The external pterygoid plate of the sphenoid bone. 7. The superior maxillary bone. 8. The tongue. 9. Section of the inferior maxillary bone. 10. The divided edge of the mylo-hyoideus muscle. 11. The genio-hyoideus muscle. 12. The genio-hyo-glossus. 13. The sublingual gland. 14. The duct of the submaxillary gland,—Wharton's duct. 15. The hyo-glossus muscle. 16. The stylo-glossus muscle. 17. The stylo-pharyngeus muscle. 18. The middle constrictor muscle of the pharynx. 19. The great cornu of the os hyoides. 20. The thyro-hyoidean membrane. 21. The ascending cornu of the os hyoides. 22. The origin of the inferior constrictor muscle of the pharynx. 23. The thyro-hyoideus muscle. 24. Part of the sterno-thyroideus muscle divided. 25. Part of the omo-hyoideus muscle. 26. The sterno-hyoideus divided at its lower part. 27. The trachea. 28. The arteria innominata. 29, 29. The right subclavian artery. 30. The common carotid artery. 31. The external carotid artery. 32. The superior thyroid artery cut short. 33. The lingual artery. 34. The facial artery. 35. The occipital artery. 36. The internal carotid artery. 37. The internal jugular vein. 38. The subclavian vein. 39. The commencement of the right vena innominata. 40. The left vena innominata. 41. The divided edge of the sternum. 42. The scalenus anticus muscle. 43. The scalenus posticus muscle. 44. The levator anguli scapulæ muscle. 45. The edge of the splenius capitis muscle. 46. The trapezius muscle.

A, A. The ninth or lingual nerve (n. hypo glossus).

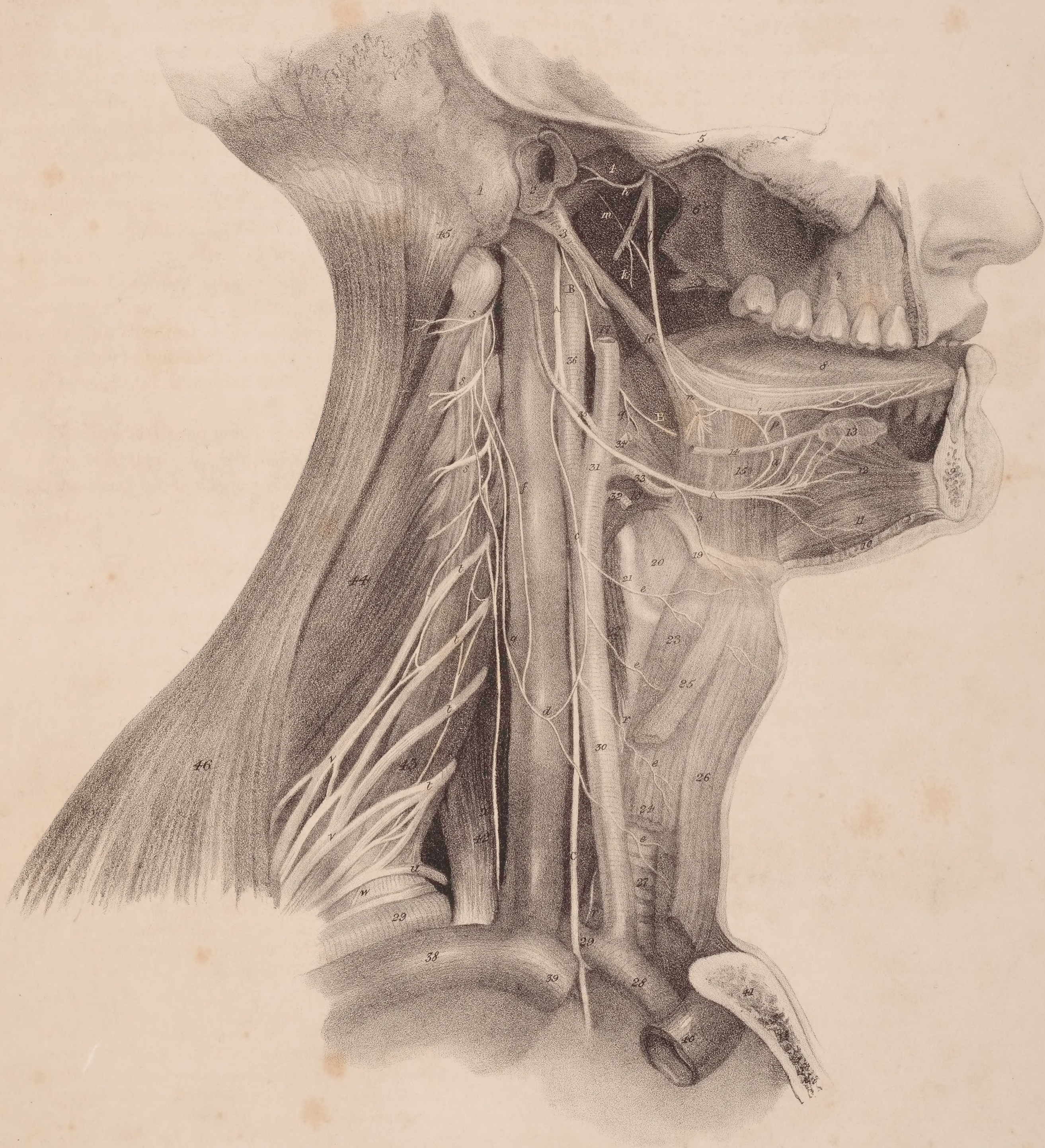
a. Branches of communication with the gustatory nerve. b. A branch to the origin of the muscles from the os hyoides. c. The nonus descendens nerve. d. The loop formed with the branch from the cervical nerves. e, e. Muscular branches to the depressors of the larynx, given off by the nonus descendens and the arch of communication. f. A filament from the second cervical nerve, and g, one from the third, uniting to form the communicating branch which forms the loop with the nonus descendens. h. The auricular nerve. i. The inferior dental nerve. k. Its mylo-hyoidean branch. l, l. The gustatory nerve. m. The chorda tympani passing to the gustatory nerve. n. The chorda tympani leaving the gustatory nerve, to join the submaxillary ganglion. o. The submaxillary ganglion. p. Filaments of communication with the lingual nerve.

B. The glosso-pharyngeal nerve.

q. Its branch to the stylo-pharyngeus muscle.

C. The pneumo-gastric or vagus nerve.

r, r. Its recurrent branch. s, s. The second, third, and fourth cervical nerves. t, t. The four inferior cervical nerves. u. The first dorsal nerve. v, v. The brachial plexus of nerves. w, w. The long thoracic nerve, or external respiratory of Bell. x. The phrenic nerve.





over the optic nerve to reach the inner side of the orbit: whilst passing over the optic nerve, it gives a small branch (f; r. ad ganglion), which terminates in the posterior and superior angle of the lenticular ganglion (g), and two filaments (k), which pierce the globe of the eye, and are distributed in the same way as the ciliary branch derived from the ganglion. At the inner wall of the orbit the nerve divides into two twigs, one (m) of which passes into the cavity of the nose (r. nasalis internus, v. ethmoidalis), the other (l) issues from the orbit beneath the trochlea, and has on that account been called the infra-trochlear branch. The nasal branch passes inwards to the cavity of the cranium, through the foramen orbitale internum anterius, and, on reaching the side of the crista galli, runs forwards on the cribriform lamella, descending into the nose through its anterior foramen or fissure. In this situation the nerve divides into two filaments, of which one (plate XI. fig. 2, D; *ramus septi*) passes down upon the septum narium, on which it divides into two or three offsets; the other runs in a groove at the inner surface of the os nasi, and, piercing the fibrous structure which connects it with the nasal cartilage, ramifies upon the tegument of the tip and ala of the nose. The infra-trochlear branch, above referred to, emerges from the orbit at the inner side of and beneath the trochlea, where it divides into filaments, which are given to the upper eye-lid, the tensor tarsi muscle, and the root of the nose; some of them also extending to the lachrymal sac and caruncula lachrymalis.

Superior maxillary nerve.—The superior maxillary nerve, or second division of the fifth (plate XIII. fig. 2, C, C: *ramus quinti paris secundus*; r. maxillaris superior), is intermediate in size, as well as in direction and situation, between the ophthalmic and inferior maxillary nerves. It passes forwards, and leaves the skull by the foramen rotundum of the sphenoid bone; after which it crosses the sphenomaxillary fossa, and enters the infra-orbital canal, through which it is conducted beneath the floor of the orbit, and finally ramifies on the cheek and side of the face. Whilst passing across the fossa, it gives two branches of communication (o), which pass down to Meckel's ganglion (p); immediately after its exit from the foramen rotundum it sends upwards into the orbit a branch (n; *orbital, nervus subcutaneus malarum*) which passes forwards, and forms an anastomosis with the lachrymal nerve, sending twigs to the lachrymal gland, some of which are continued along the outer margin of the orbit, to be distributed to the orbicular muscle and the integument; and also a filament which passes through the malar bone to the temporal fossa, and communicates with one of the deep temporal branches. The *posterior dental* branches (t, t), three or four in number, descend upon the tuberosity of the

PLATE XVII.

This plate shows the brachial plexus with its branches, the nerves of the upper extremity.

- No. 1. The scalenus anticus muscle crossed by the phrenic nerve. 2. The sternal portion of the clavicle. 3. The trapezius muscle. 4. The scapular portion of the clavicle. 5. The coracoid process. 6. The coracobrachialis muscle. 7. The short head of the biceps. 8. Its long head. 9. The deltoid muscle. 10. The brachialis anticus muscle. 11. The lower part of the biceps muscle. 12. The internal head of the triceps muscle. 13. The middle or long head of the triceps. 14. The edge of the latissimus dorsi muscle. 15. The serratus magnus muscle. 16. The origin of the pectoralis minor muscle. 17. The subscapularis muscle. 18. The subclavian artery. 19. The axillary artery. 20, 20. The brachial artery.
- a. The anterior division of the fifth cervical nerve. b. The anterior division of the sixth cervical nerve. c. The anterior division of the seventh cervical nerve. d. The anterior division of the eighth cervical nerve. e. The anterior division of the first dorsal nerve. f. The two filaments of origin of the long thoracic nerve, the external respiratory of Sir Charles Bell. g. The long thoracic nerve. h. The phrenic nerve, or internal respiratory nerve.
- A. The brachial plexus.
- i, i. The short thoracic nerves. k. The supra-scapular nerve. l, l. Subscapular nerves.
- B, B. The external cutaneous nerve (musculo-cutaneous, nervus perforans Casserii).
- m. A branch to the short head of the biceps muscle. n. A muscular branch piercing the coracobrachialis muscle. o. A branch to the biceps muscle; its filaments are cut away. p, p. Branches to the brachialis anticus muscle. q. The cutaneous portion of the nerve dividing into two branches to supply the integument of the fore-arm.
- C, C. The median nerve (nervus medianus).
- r. Its external head. s. Its internal head.
- D, D. The internal cutaneous nerve (nervus cutaneus internus).
- t. Its anterior branch. u. Its posterior branch.
- E, E. The ulnar nerve (nervus ulnaris).
- v. Muscular branches to the triceps muscle.
- F. The musculo-spiral nerve (nervus radialis). G. Circumflex nerve (nervus circumflexus brachii vel axillaris).
- x, x. The intercosto-humeral nerve (nerve of Wrisberg) from the second dorsal nerve. y. The intercosto-humeral nerve from the third dorsal nerve.

superior maxillary bone, and enter the foramina observable on its surface: through these the filaments descend to the alveoli of the molar teeth, in the pulp of which they ramify: one filament will be observed to run along the alveolar border of the superior maxilla, supplying the gums. Before it emerges on the face, the superior maxillary nerve sends downwards a branch (v; *anterior dental*), which divides into three or four filaments, for the supply of the bicuspid, canine, and incisor teeth. At its exit from the infra-orbital foramen, the nerve (w) is concealed by the orbicularis and levator labii superioris muscles, where it divides into a number of branches, some of which incline inwards to the nose, and communicate with the nasal branch of the ophthalmic nerve; others pass downwards upon the cheek and upper lip; and a third set incline somewhat outwards, forming a complete mesh by their interlacement with the branches of the facial or portio dura nerve.

Inferior maxillary nerve.—The inferior maxillary nerve (plate XIII. fig. 2, D), the third and largest branch of the fifth pair, (*ramus tertius quinti paris*; *r. infra-maxillaris*), is made up, as has been said, of two portions, which issue from the cranium by the foramen ovale of the sphenoid bone, and become united immediately after their exit. A few lines beneath the base of the skull, in which situation it is under cover of the pterygoideus externus muscle, the nerve divides into two primary branches. One of these (x), which lies superior to the other, and also is smaller than it, soon subdivides into five offsets, which are distributed to the deep-seated muscles as follow:—The deep temporal branches (y), two in number, (*r. temporales profundi*, anterior and posterior,) at first pass outwards between the external pterygoid muscle and the bone, one of them at the same time inclining forwards; they then ascend, and become applied to the inner surface of the temporal muscle, to which most of them are distributed; some, however, pierce its fibres and fascia, and, becoming superficial, anastomose with the superficial temporal branches of the facial nerve. The buccal branch (b*; *r. buccalis*) is longer than any of the others; it inclines downwards and forwards between the pterygoid muscles, and reaches the surface of the buccinator muscle, on which it spreads out into four or five filaments, which communicate with branches of the facial nerve, supplying the muscles of the cheek and lips. In its course it furnishes some twigs to the external pterygoid and temporal muscles. This nerve is sometimes found to arise by a common trunk with, or to give off, one of the preceding (temporal) branches. The pterygoid nerve (n. pterygoideus) passes between the pterygoid and circumflexus palati muscles, to ramify in the internal pterygoid; there is frequently more than one pterygoid twig. The masseteric branch (z; *r. massetericus*) is directed transversely outwards in front of the glenoid fossa of the temporal bone, passes between the temporal and external pterygoid muscles, and finally escaping through the sigmoid notch of the lower maxillary bone, supplies the muscle from which its name is derived.

The remaining division of the inferior maxillary nerve subdivides into three branches, viz. the gustatory, auricular, and inferior dental.

The gustatory nerve, (plate XIII. fig. 2, c*; n. gustatorius v. lingualis,) immediately after its origin, sends a short branch, of considerable thickness, to the dental nerve: lying anteriorly to this, it then descends between the pterygoid muscles for some way, where it is joined at an angle by the chorda tympani nerve (d*), which accompanies it whilst descending inside the ramus of the lower maxillary bone, but soon parts from it (e*), to be distributed to the submaxillary gland. The gustatory nerve continues its course forwards, under the mucous membrane of the mouth, to reach the side of the tongue, passing between the hyo-glossus and mylo-hyoideus muscles, in company with the duct of the submaxillary gland. As it ascends by the side of the tongue, it gets above the sublingual gland, and divides into several minute filaments, which may be traced beneath the mucous membrane, gradually becoming soft and waving, until they reach the papillæ, where they terminate. The nerve, during its course, gives one or two filaments to the internal pterygoid muscle, also some which communicate with the hypoglossal nerve, and others to the sublingual gland.

The auricular or superficial temporal branch, (plate XIII. fig. 2, i: *r. meatûs auditorii externi*, Meckel; *temporalis superficialis*), often commences by two roots; it inclines outwards, to gain the interval between the condyle of the lower jaw and the meatus auditorius externus, where it divides into two branches, whilst lying deeply in the substance of the parotid gland. One of these branches ascends behind the neck of the condyle of the lower jaw, between the articulation and the meatus externus of the ear; gradually becoming superficial, it divides into offsets, which mount up in the temporal fossa, taking the course of the temporal artery, its filaments being traced to the tegument upon the side of the head; at its commencement it gives a branch which joins the facial nerve, and in its course one to the articulation of the lower jaw and the meatus auditorius. The inferior branch

divides into offsets, which passing through the parotid gland reach the lobule and tegument of the ear, and communicate with the posterior branches of the second cervical nerve.

The inferior dental nerve (plate XIII. fig. 2, f* ; n. dentalis), usually receiving at its commencement a short thick branch from the gustatory, arises as it were by two roots, (between which the internal maxillary artery passes,) and is the largest of the branches of the inferior maxillary nerve. It descends at first between the two pterygoid muscles close to the gustatory, then passes between the internal pterygoid and the ramus of the inferior maxilla, protected from the action of the former by the internal lateral ligament of the temporo-maxillary articulation, and arrives at the orifice of the dental canal which occupies the inner surface of the ramus of the inferior maxillary bone. At this point a long delicate branch (g* ; *ramus mylo-hyoideus*) is given off, which inclines downwards and forwards in a groove marked for it on the inside of the ramus of the jaw. This branch rests on the inferior surface of the mylo-hyoideus muscle, to which, as well as to the submaxillary gland and anterior belly of the digastricus, it gives filaments. The dental nerve, having entered the canal appropriated to it in the lower jaw, passes horizontally forwards about three lines beneath the roots of the teeth, to each of which it sends filaments, which incline obliquely upwards, and enter the foramina in their apices, to be distributed to their central pulp. When arrived opposite the foramen mentale, the nerve divides into two branches, one of which, smaller than the other, continues in the canal as far as the symphysis of the chin, where it anastomoses with the corresponding nerve of the opposite side ; and from the arch thus formed filaments ascend to supply the canine and incisor teeth. The other division of the nerve (h* ; *ramus mentalis*) passes through the foramen, and appears on the face, where it ramifies freely in the muscles and integuments of the chin and lip, its filaments communicating with those of the facial nerve.

Spinal nerves.—The spinal nerves (plate I. fig. 2) are thirty-one pairs in all ; and each individual nerve is attached by two sets of filaments, one to the anterior, the other to the posterior surface of the spinal cord. These unite into one short trunk, which, as it passes out of the intervertebral foramina, divides into two branches, one anterior, the other posterior, which are distributed respectively to the parts in front of and behind the vertebral column. The anterior branches are, with one or two exceptions to be noticed in the special description of the nerves, larger than the others, and form the several plexuses found in different situations. These nerves are usually arranged in four groups, from a consideration of the regions in which they are situated, viz. cervical, dorsal, lumbar, and sacral.

The cervical nerves are sometimes described as eight, sometimes as seven, in number ; the difference depending on the place assigned to that which emerges from the spinal canal above the first vertebra of the neck.

First cervical nerve.—The first cervical nerve (plate I. fig. 2 ; nervus sub-occipitalis, decimus cerebri) is the smallest of the spinal nerves, except the last sacral. Willis and several succeeding anatomists considered it as one of the cerebral nerves ; but Sœmmering, Meckel, and Bell have on just grounds associated it with those that arise from the spinal column, because, like them, it arises by two roots, presents a ganglion on the posterior one, and in its general distribution is analogous to those which succeed it. This nerve passes out between the arch of the atlas and the occipital bone, lying in the groove on the upper surface of the former, and reaches the triangular space bounded by the recti and obliqui muscles, where it divides into an anterior and a posterior branch. The latter resolves itself into four or five filaments, which are distributed to the small muscles just mentioned, and to the complexus. It may be here observed, that the posterior branches of the three upper cervical nerves mutually communicate by a filament sent from one to the other, previously to their final division, so that an interlacement is formed between them, though it does not receive the name of plexus. The *anterior* branch of the first cervical nerve, smaller than the posterior, runs obliquely forwards upon the transverse process of the atlas, and, on reaching the anterior surface of the spinal column, descends and joins with a branch sent up from the second nerve, having previously given some filaments to the muscles by which it passes. At the point of union also some twigs are sent to communicate with the lingual and vagus nerves and the superior cervical ganglion, at the base of the skull ; a slender filament descends with the vertebral artery in its canal.

Second, third, and fourth cervical nerves.—The second, third, and fourth cervical nerves may in their description be taken together, inasmuch as by their anterior branches they form the cervical plexus. Their posterior branches shall be described in the first instance.

Posterior branches.—The posterior branch of the second cervical nerve (plate XIV. s), of greater

size than the anterior, passes backwards and upwards, covered by the complexus, and resting on the rectus posticus and obliquus inferior. To these, as well as to the splenius, it gives ramusculi, and finally having pierced the fibres of the complexus, becomes subcutaneous, ramifying in the skin of the occiput. It communicates with the corresponding branches of the nerves next to it, namely, the first and third. The posterior branch of the third nerve, less in size than the anterior, passes backwards by the articulation of the second and third vertebra, anastomoses with the preceding branch, and supplies filaments to the muscles in its neighbourhood; finally it pierces the muscles and ascends, becoming subcutaneous, and ramifies on the back part of the head and neck. The posterior branch of the fourth is smaller than either of those above it, except the first. It passes directly backwards between the transverse processes of the third and fourth vertebræ, and having given several filaments to the complexus muscle, pierces the splenius and trapezius, supplying both, and ultimately terminates in the integuments of the neck.

Anterior branches.—The anterior branches of the second, third, and fourth nerves communicate by small twigs with the superior cervical ganglion, and will be observed, as soon as they appear on the fore part of the neck, to send filaments mutually one to the other, in order to form the cervical plexus. The *cervical plexus* (plate XVI. s, s), thus formed, is placed at the upper and lateral part of the neck; it extends from the transverse process of the second to that of the fourth vertebra, resting on the fibres of the posterior scalenus and levator scapulæ muscles, and concealed by the sterno-mastoid. Its branches are divisible into a superficial and a deep set; the latter being placed under cover of the sterno-mastoid, whilst the former lie immediately beneath the fascia, some of them passing up towards the jaw and ear, others down to the clavicle.

1. *Superficial branches (ascending; plate XIV.)*—These, as they issue from the plexus, are three in number. They turn round the posterior border of the sterno-mastoid muscle, and will be observed to differ in size and direction as they lie upon its cutaneous surface. The middle or largest branch (1; *nervus auricularis magnus*, Scëmm.; *zigomato-auriculaire*, Chauss.) ascends perpendicularly

PLATE XVIII.

The superficial and deep nerves of the front of the fore-arm are here shown. In fig. 1, the fascia has been left, and the superficial nerves are seen lying on its surface. In fig. 2, the superficial muscles of the fore-arm have been removed so as to show the course and relations of the different nerves.

Fig. 1. No. 1. The tendon of the palmaris longus muscle, continuous with the palmar fascia. 2. The palmar fascia. 3. The palmaris brevis muscle. 4. The abductor pollicis muscle covered by a thin layer of fascia.

A. The internal cutaneous nerve.

a. Its posterior branches. b. Its anterior branches. c. Filaments of communication with the external cutaneous nerve. d. A filament of the ulnar nerve uniting with a branch of the internal cutaneous.

B. The external cutaneous nerve.

e. Its posterior branch. f, f. Its anterior branches. g. A branch of communication from the radial nerve. h. The radial cutaneous nerve. i. The palmar cutaneous nerve, a branch of the median.

Fig. 2. No. 1. The lower part of the biceps muscle. 2. The brachial artery. 3. The inner head of the triceps muscle. 4, 4. The external head of the pronator radii teres muscle cut through. 5. Its internal head. 6. The origin of the flexor carpi radialis muscle divided. 7, 7. The flexor carpi ulnaris muscle. 8, 8. The flexor profundus digitorum muscle. 9, 9. The ulnar artery. 10. The interosseous artery. 11. The flexor longus pollicis muscle. 12, 12. The radial artery. 13. The supinator brevis muscle. 14. The extensor carpi radialis longior. 15. The supinator longus muscle. 16. The pronator quadratus muscle. 17. The tendon of the palmaris longus muscle. 18. The superficialis volæ artery. 19. The abductor pollicis muscle. 20. The flexor brevis pollicis muscle. 21. The adductor pollicis muscle. 22, 22. The tendons of the flexor profundus digitorum muscle. 23. The superficial palmar arch. 24. The adductor minimi digiti muscle. 25. The abductor minimi digiti. 26, 26. The lumbricales muscles.

A. The termination of the musculo-spiral nerve.

a. The radial nerve. b. The posterior interosseous nerve.

B, B. The median nerve.

c. A branch supplying the pronator radii teres muscle and elbow joint. d. Branches to the superficial muscles of the fore-arm. e. The anterior interosseous nerve. f. The superficial palmar nerve. g. A branch to the muscles of the ball of the thumb. h. Collateral branches to the thumb. i. Digital branch of the first finger. k, k. Digital branches of the middle and ring fingers. l, l. Posterior branches of the digital nerves.

C, C. The ulnar nerve.

m, m. Muscular branches. n. Cutaneous branch. o. Dorsal branch. p. Communicating branch with the median. q. Superficial palmar branch. r, r. Deep palmar branch.

Fig. 1.



Fig. 2.



Plate 19

Fig. 1.



Fig. 2.



towards the interval between the lobe of the ear and the angle of the jaw, lying close to the external jugular vein, and, on reaching the parotid gland, divides into branches, one or two of which pass deeply into its substance and join with those of the facial nerve. The rest of the branches remain superficial, and ramify in the integument of the external ear, some at its facial, and one or two at its occipital aspect. The internal branch (m; *r. superficialis colli*) inclines obliquely up towards the submaxillary gland, giving filaments to the platysma and digastricus, also one or two which join with the cervical branches of the facial nerve: it finally divides into delicate filaments, which interlace with those of the chorda tympani and of the gustatory, as they ramify on the submaxillary gland, forming a sort of plexus by their union. The *posterior* branch (o; *r. occipitalis minor*) runs along the posterior border of the mastoid muscle, lying on the splenius, and terminates by three or four filaments in the integument of the occiput and ear, anastomosing with a branch of the portio dura.

Superficial branches (descending; plate XIV.).—These as they come from the plexus will be seen in the interval between the contiguous borders of the sterno-mastoid and trapezius, diverging as they pass down to the lower part of the neck. They are embedded in a considerable quantity of cellular tissue, and as they diverge to their destination, one set passes over the clavicle (p, p; *r. claviculares*), and supplies the integument on the upper part of the thorax; another on the acromion (*r. acromiales*); whilst some lie rather deeply behind the clavicle, being distributed to the posterior belly of the omo-hyoideus and to the serratus magnus.

2. *The deep branches*.—A few pass backwards, communicate with the spinal accessory nerve, and ramify in the trapezius and levator anguli scapulæ muscles. The other branches of this series are arranged into two divisions: one of these consists of two filaments (plate XVI. f, g), derived from the second and third nerves, which incline inwards as they descend in front of the sheath of the cervical vessels, to join the descendens noni (c), and form with it an inverted arch. From the convexity of this arch, which looks downwards, three or four long waving filaments (e, e) proceed towards the front of the neck, where they are distributed to the sterno-hyoideus and sterno-thyroideus, as well as to the omo-hyoideus muscles. The other division consists of two branches, which converge and unite on the scalenus anticus to form the *phrenic nerve* (x).

The phrenic nerve (plate XIV. q; plate XVI. x).—The branches which form it will be observed to come from the third and fourth nerves; but they are further increased by a branch derived from the fifth, as it descends to the axillary plexus. The phrenic nerve thus constituted lies on

PLATE XIX.

The nerves of the posterior part of the fore-arm are here shown.

Fig. 1. The superficial nerves resting on the deep fascia.

a. The posterior branch of the internal cutaneous nerve. b. Branches distributed to the integument around the olecranon. c. Branch of communication with the radial cutaneous nerve. d. Radial cutaneous nerve (nervus cutaneus externus superior). e. Posterior branch of the external cutaneous nerve. f. Another branch of the external cutaneous nerve. g. The radial nerve. h. The posterior collateral branch to the thumb. i. The branch of the first metacarpal space. k. The branch of the second metacarpal space. l. The dorsal branch of the ulnar nerve piercing the fascia, and becoming superficial. m. Its communicating branch with the radial. n. A branch of the internal cutaneous nerve.

Fig. 2. A deep view of the nerves supplying the posterior aspect of the fore-arm. The triceps muscle has been removed from its insertion in the upper arm; and the extensor communis digitorum, extensor digiti minimi, and extensor carpi ulnaris have been dissected away from the fore-arm.

No. 1. The lower part of the humerus. 2, 2. The posterior surface of the brachialis anticus muscle. 3. The biceps. 4. The supinator longus muscle. 5. The anconeus muscle. 6. The olecranon process of the ulna. 7. The flexor carpi ulnaris muscle. 8, 8. The ulna. 9, 10. The indicator and extensor secundi internodii pollicis muscles drawn aside with a hook. 11. The extensor primi internodii muscle. 12. The extensor ossis metacarpi pollicis muscle. 13. The supinator brevis muscle. 14. The extensor carpi radialis longior. 15. The lower part of the radius. 16. The interosseous membrane. 17. The tendon of the extensor carpi radialis brevior. 18. The tendon of the extensor carpi radialis longior. 19. The tendon of the extensor secundi internodii pollicis. 20. The abductor indicis muscle. 21, 21. Dorsal interossei muscles. 22. The abductor minimi digiti muscle.

A. The musculo-spiral nerve.

a. A branch of the musculo-spiral nerve distributed to the joint. b. The posterior branch of the musculo-spiral nerve (nervus profundus vel muscularis). c. The posterior interosseous nerve (nervus interosseus posticus). d. The ganglion formed upon the posterior interosseous nerve at its distribution to the wrist joint. e. The radial nerve.

B. The ulnar nerve, passing behind the inner condyle of the humerus.

f. Its dorsal branch. g, g. The dorsal collateral branches of the digital nerves.

the scalenus anticus, near its inner border, and passes into the thorax, to be ultimately distributed to the diaphragm.

Fifth, sixth, seventh, and eighth cervical nerves.—The four inferior cervical nerves, namely, the fifth, sixth, seventh, and eighth, divide, like the preceding, into anterior and posterior branches. The latter are small; they pass backwards from the intervertebral foramina, and supply the muscles and integuments at the lower part of the neck.

Brachial plexus.—The anterior branches of these nerves are of very considerable size, much larger than those which form the cervical plexus. After emerging from the intervertebral foramina, they receive some filaments from the inferior or middle cervical ganglia of the sympathetic; and, being joined by the corresponding branch of the first dorsal nerve, unite in a peculiar way to form an interlacement called the *brachial* or *axillary plexus* (plate XVI. v, v), which extends from opposite the sixth cervical vertebra to the coracoid process. In the neck, the branches which form it lie between the scaleni muscles; closely aggregated together, they pass downwards and outwards into the axillary space, between the subclavius muscle and the first rib, and are placed at the acromial side of the accompanying artery.

The branches which form this plexus are said by Boyer, and other anatomists, to interlace inextricably. An arrangement of them, however, may be made as follows:—a probe may be previously passed across, through the primary divisions of the plexus, so as to divide them into an anterior and posterior set. The anterior branches of the fifth and sixth cervical nerves will be observed, after coming out of the intervertebral foramina, to unite and form a common trunk, which, after giving off the supra-scapular nerve, separates into two divisions. Of these, one, posterior in situation, descends to form the circumflex nerve, and gives a small slip to form the spiral: the anterior division unites with a similar one from the seventh, and the common trunk thus resulting gives at its upper side the external cutaneous nerve; at the lower, the outer head of the median. The first dorsal nerve ascends to join the last cervical, to form a common trunk, which also separates into two divisions. The posterior one unites with a similar offset from the seventh to form the spiral nerve; whilst the anterior, after giving off from its inner side the internal cutaneous nerve, divides ultimately into the ulnar nerve and the inner head of the median.

Brachial plexus—its branches.—From this nervous interlacement several nerves proceed, which may be divided into three sets:—1. The first consists of those which pass off rather higher up from the plexus, viz. the supra-scapular, the sub-scapular, and the thoracic, the latter consisting usually of three branches, all, however, going to nearly the same destination. Opposite the coracoid process, the plexus divides into six ultimate branches, for the supply of the limb, which may be resolved into—2, those which reach the hand and fingers, consisting of the ulnar, median, and spiral nerves; and 3, those which do not extend so far, namely, the internal cutaneous, the external cutaneous, and the circumflex nerves.

Nerves of the superior extremity.—The first set of these nerves, according to the division above indicated, consists of the supra-scapular, the sub-scapular, and the thoracic nerves or branches.

Supra-scapular nerve.—The supra-scapular nerve (plate XVII. h; *n. supra-scapularis*) passes off from the plexus as high up as opposite the sixth cervical vertebra. Its direction is backwards and outwards, as it descends to the superior border of the scapula. The nerve passes through the supra-scapular notch or foramen, and so reaches the dorsum of the scapula, where it gives branches, first, to the supra-spinatus muscle, and then continues its course upon the neck of that bone, until it arrives in the infra-spinal fossa, where it terminates by ramifying in the muscles.

Sub-scapular nerves.—The sub-scapular nerves (plate XVII. l, l; *n. sub-scapulares*) pass backwards from the plexus, at first lying deeply in the axillary space; they are usually three in number. One, the smallest of the three, enters the sub-scapular muscle, and is distributed to its substance. The others not unfrequently arise by a common trunk, but sometimes separately; both proceed in the same course as the sub-scapular artery, one supplying the muscle of that name, as well as the teres major and minor; whilst the other, somewhat larger, pierces the teres major, and ramifies in the latissimus dorsi.

Thoracic nerves.—The thoracic nerves (plate XVII. i, i; *n. thoracici*) are usually three in number. Of these, two may be observed to pass down on the fore part of the thorax, lying in front of the axillary vessels, and to terminate by ramifying in the substance of the pectoralis major and minor muscles. Another very long branch (g) commences by two filaments (f), which soon unite to form a thin, flat nerve, that lies behind the plexus and the axillary vessels. It descends along the thoracic side of the axillary space, resting upon the serratus magnus muscle, to which in its course it gives

branches, and finally terminates by ramifying in the lower part of that muscle. This nerve, from its situation, is called the posterior thoracic branch. Sir C. Bell classes it amongst the respiratory nerves, as, according to his views, its function is to associate the muscle to which it is distributed with the general respiratory movements. From its situation it is named the *external respiratory nerve*, to distinguish it from the phrenic, which is placed within the thorax.

Internal cutaneous nerve.—The internal cutaneous nerve (plate XVII. D ; plate XVIII. fig. 1, A: *n. cutaneus internus*), commencing at the inferior and internal part of the plexus, descends along the inner side of the arm, being the smallest and most superficial of the nerves derived from the plexus. It lies for some way covered by the fascia of the arm, and divides, at a variable distance above the elbow, into two branches, which separately pierce the fascia. One of these may be observed to cross in front of the median basilic vein, and then to descend along the fore part of the arm, gradually inclining towards its inner side. It distributes several filaments to the skin, and maintains communications with the external cutaneous nerve on the one hand, and with the larger branch, or proper continuation of the internal cutaneous, on the other, and finally ceases at the wrist. The other division of the nerve is larger than the preceding, and lies nearer to the inner condyle of the humerus. At the bend of the elbow it inclines towards the ulnar border of the fore-arm, distributing filaments on each side as it descends, which freely ramify in the integument. Towards the carpus the nerve is necessarily much diminished, after having given off so many branches; its final ramifications may be traced as far as the skin over the inner border of the hand. Previously to reaching the elbow, and before its division, the nerve sends off several small and delicate branches to supply the skin that covers the biceps and triceps muscles.

External cutaneous nerve.—The external cutaneous nerve (plate XVII. B ; plate XVIII. fig. 1, B: *musculo-cutaneus, nervus perforans Casserii*) issues from the superior and external part of the plexus, being intermediate in size between the preceding nerve and the ulnar. Its direction is outwards and downwards, so as to reach the border of the coraco-brachialis muscle, the fibres of which it in most cases pierces, but sometimes passes behind it. In either case, the nerve passes between the biceps and brachialis anticus muscles, where it gives off three or four branches to the muscles between which it lies, the continuation of the nerve being intended for the skin, whence its name, *musculo-cutaneous*. After this the nerve inclines outwards as it descends, reaches the outer border of the arm, and pierces the fascia, so as to come into contact with the median cephalic vein, behind which it lies. The nerve is thus placed between the fascia and integument, at the external or radial border of the fore-arm, along which it continues to descend as far as the wrist, where it terminates by dividing into two sets of filaments, one of which ramifies in the skin covering the anterior, the other in that on the posterior aspect of the carpus.

The branches given off by the nerve in its entire course are divisible into two sets, one muscular, the other cutaneous, whence its name. The muscular branches (plate XVII. m, n, o, p) consist of three or four filaments distributed to the flexor muscles; one may be traced for some way in the interior of the coraco-brachialis, arising from the nerve whilst passing through its substance, or beneath it; the others go to the biceps and brachialis anticus, one communicating with the median nerve. The cutaneous branches (plate XVII. q ; plate XVIII. fig. 1, e, f) not only supply the integument of the fore-arm, but also maintain communications with the internal cutaneous nerve on the one hand, and the cutaneous branches of the spiral nerve on the other, by filaments which take a curved direction, and unite with similar offsets from the nerves just mentioned, so as to form arches, whose convexity, for the most part, looks down towards the hand. Finally, on the fore part of the wrist and root of the thumb, its terminal branches unite, in the same way with the cutaneous branches sent by the median nerve, to the integument on the palm of the hand.

Circumflex nerve.—The circumflex, or axillary nerve (plate XVII. G ; *n. circumflexus brachii v. axillaris*), is deeply seated, and altogether concealed by the plexus. It passes outwards and backwards immediately after its origin, and soon comes into contact with the posterior circumflex artery. The nerve and artery will be observed to run together close behind the shaft of the humerus, in order to reach its external aspect, where they both turn forwards somewhat, so as to lie between the bone and the deltoid muscle, to which the branches of both are finally distributed. The long head of the triceps lies behind the nerve in the first part of its course, and the sub-scapularis above it, the teres major being below it. To each of these, filaments are given; and where it turns beneath the deltoid, a considerable branch descends, becoming superficial, and is distributed to the skin covering that muscle and the triceps extensor.

Ulnar nerve.—The ulnar nerve (plate XVII. E, E ; plate XVIII. fig. 2, C, C: *n. ulnaris*), inter-

mediate in size between the external cutaneous and median nerves, is usually detached from the plexus opposite the lower border of the sub-scapular muscle. It inclines a little backwards as it descends along the arm, resting on the short head of the triceps, until it reaches the interval between the inner condyle of the humerus and the olecranon. There the nerve, after passing through the interval between the heads of the flexor carpi ulnaris muscle, reaches the fore-arm, along which it descends close to its ulnar border, resting on the flexor profundus muscle, and covered by the flexor carpi ulnaris. Towards the lower part of the fore-arm the nerve lies close to the radial border of the tendon of the last-named muscle, along which it runs, in company with the ulnar artery, to the pisiform bone and annular ligament of the wrist. Having passed in front of the latter, it divides into two branches, one being superficial, the other deep-seated.

The *superficial* branch (plate XVIII. fig. 2, q), the larger of the two, soon gives off, at its inner side, a considerable branch, which inclines towards the ulnar border of the hand, lying upon the short muscles of the little finger, to which it gives filaments. On reaching the head of the metacarpal bone, it proceeds along the inner margin of the digital phalanges to their extremity, forming the internal collateral branch of the little finger. Continuing its course directly forwards, the superficial branch rests on the abductor muscle of the little finger, where it gives an offset (p) from its radial side, which joins with the last digital branch of the median nerve; and, finally, on arriving opposite the heads of the metacarpal bones (fourth and fifth), it divides into two ramusculi, which run along the contiguous borders of the ring and little fingers.

The *deep-seated palmar* branch (r, r) of the ulnar nerve becomes concealed from view by passing beneath the adductor of the little finger. It then inclines outwards across the metacarpus, covered by the flexor tendons, resting on the inter-ossei, and terminates by two or three filaments, which ramify in the adductor pollicis. The deep nerve, like the corresponding artery, forms an arch, whose convexity is turned towards the fingers, and, in its course, branches are given off on each side to the inter-ossei muscles, as well as to the small muscles of the little finger.

The ulnar nerve distributes several branches, which, if taken in the order of their occurrence, will be found as follow: 1, at the lower border of the axilla, one or two filaments are given to the teres major and latissimus dorsi; 2, in the arm a few branches pass into the substance of the long and short heads of the triceps muscle, on which the nerve lies; 3, in the fore-arm, numerous branches are given to the contiguous muscles, viz. the flexor carpi ulnaris and flexor profundus, and also some filaments, which maintain communications with the branches of the median nerve; 4, at the union of the middle with the lower third of the fore-arm, a branch of considerable size (plate XVIII. fig. 2, o) inclines backwards from the nerve, and reaches the dorsal aspect of the limb, after having passed beneath the flexor ulnaris muscle. Continuing to descend, it lies superficial to the extensor carpi ulnaris, and so reaches the back of the hand, where it sends a branch along the inner border of the fifth metacarpal bone, which gives filaments to the abductor of the little finger, and finally runs along its ulnar margin as far as the last phalanx. The continuation of the nerve corresponds in its course with the fourth metacarpal space, giving off several small filaments to the skin and parts on the back of the hand, and, on reaching the heads of the metacarpal bones, divides into two branches, which extend upon the contiguous margins of the little and ring fingers, in their entire length, forming their collateral branches. From the radial side of the nerve a branch not unfrequently is

PLATE XX.

Fig. 1. A section of the thorax, showing the distribution of the intercostal nerves.

Nos. 1, 1. The dorsal portion of the vertebral column. 2, 2. The inner surfaces of the ribs of the left side. 3, 3. The external intercostal muscles. 4, 4. The internal intercostal muscles.

a, a. The intercostal nerves (n. intercostales, vel dorsales) emerging from the intervertebral foramina. b, b. The anterior branches (rami intercostales). c, c. The posterior branches (rami dorsales, vel postici). d, d. The anterior branches, or intercostal nerves, of the left side. e, e. Muscular branches. f, f. The superficial or cutaneous branches piercing the external intercostal muscles.

Fig. 2. A superficial view of the side of the trunk, showing the distribution of the cutaneous nerves.

No. 1. The external oblique muscle. 2. The latissimus dorsi. 3. The fascia covering the gluteus medius muscle. 4. The gluteus maximus.

a, a. Superficial or cutaneous branches of the inferior intercostal nerves. b, b. Cutaneous branches reflected backwards. c, c. Cutaneous branches from the dorsal branches of the intercostal nerves. d, d. Cutaneous branches from the musculo-cutaneous branches of the lumbar plexus. e. Cutaneous branch from one of the lumbar nerves.

Fig. 1.

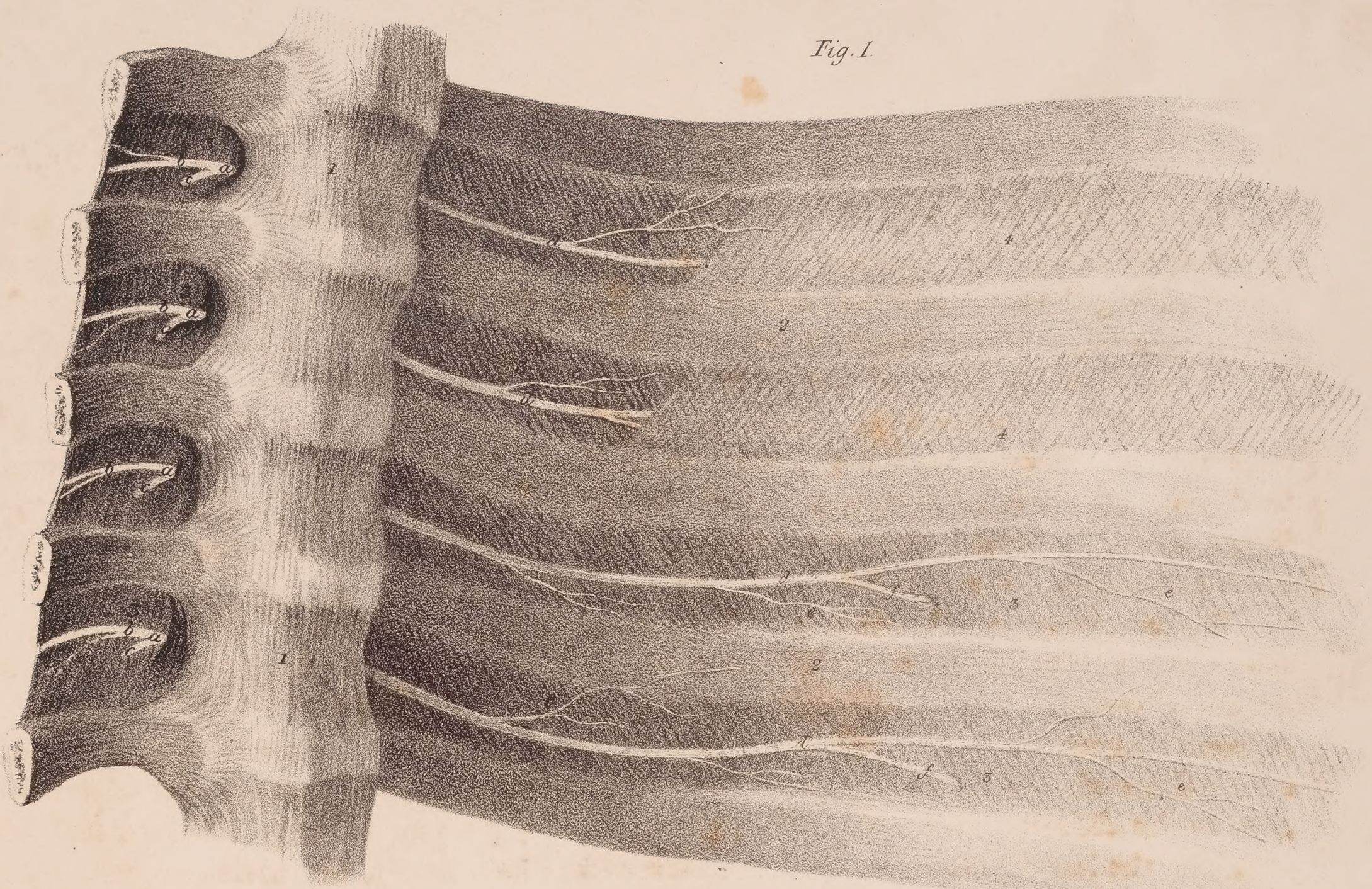
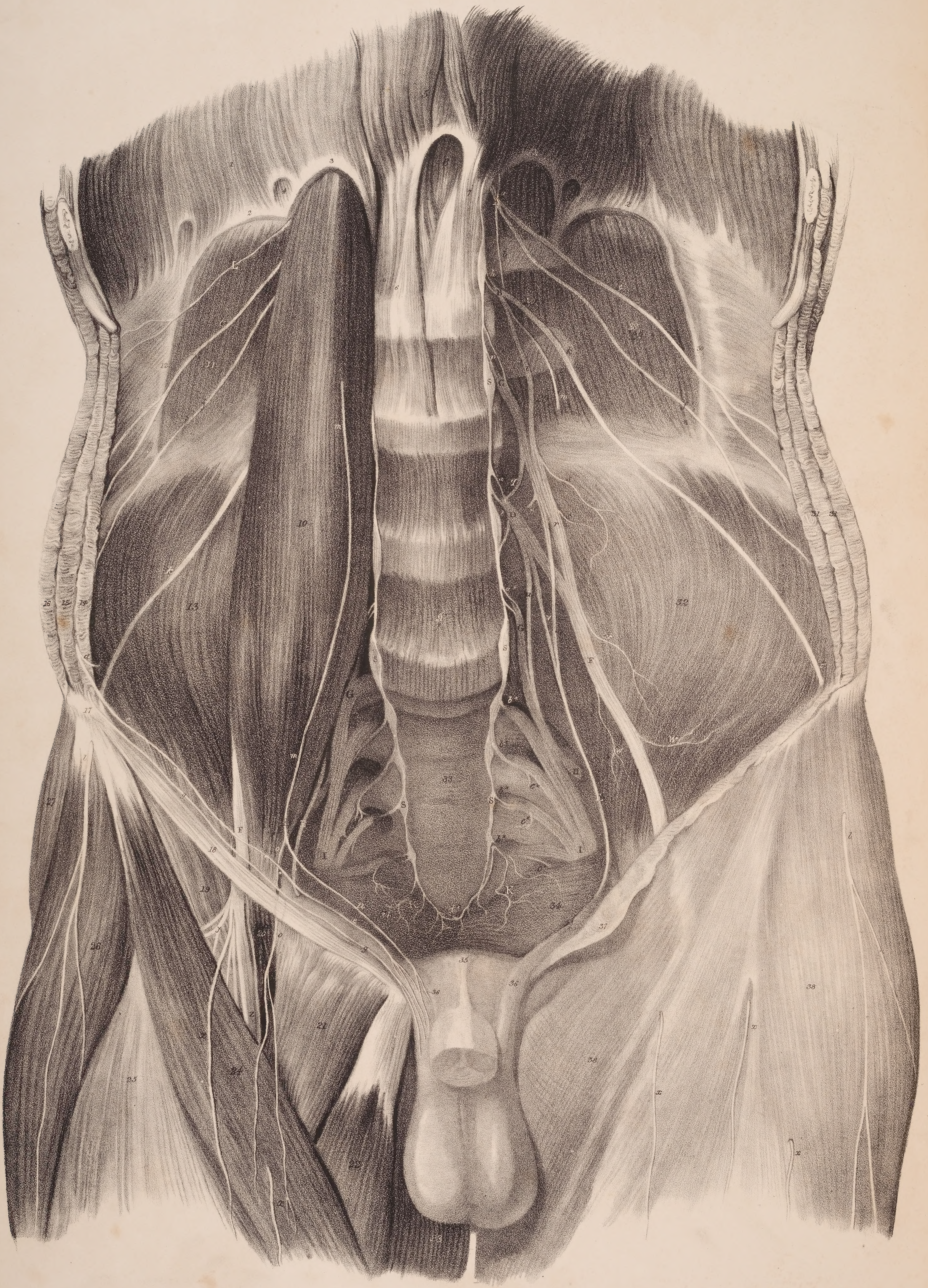


Fig 2





sent, which supplies also the external border of the ring finger, and the adjacent one of the middle finger. But it will sometimes be observed that this branch joins with some derived from the termination of the spiral nerve, and that from their union branches proceed to supply the contiguous borders of the ring and middle fingers.

Median nerve.—The median nerve (plate XVII. C, C; plate XVIII. fig. 2, B, B: *n. medianus*) is so called from the position which it occupies in the fore-arm. It is of considerable size, and arises from the plexus by two fasciculi, or heads, which embrace the axillary artery. The artery, in this situation, is surrounded on every side by the divisions of the plexus. In front lies the median nerve, behind it are placed the circumflex and spiral, to the outer side one of the heads of the median, together with the external cutaneous nerve, and to the inner, the second head of the median, with the

PLATE XXI.

In this plate the lumbar plexus is seen, together with its branches. The dissection has been effected by removing the anterior parietes of the abdomen and the viscera. On the right side the psoas muscle is left; on the opposite side it has been taken away to show the manner of formation of the plexus. The sacral plexus is also shown.

- Nos. 1, 1. Part of the greater muscle of the diaphragm. 2, 2. The ligamenta arcuata externa. 3, 3. The ligamenta arcuata interna. 4, 4. The openings for the lesser splanchnic nerves. 5. The lesser muscle of the diaphragm. 6. Its long origin. 7. Its short origin. 8. The aortic opening. 9. The fifth lumbar vertebra. 10. The psoas magnus muscle. 11. The quadratus lumborum of the right side. 12. The cut edge of the anterior aponeurotic lamella of the transversalis muscle: the lamella has been removed to show the quadratus muscle. 13. The iliacus internus muscle. 14. The divided edge of the transversalis muscle. 15. The divided edge of the internal oblique muscle. 16. The divided edge of the external oblique muscle. 17. The anterior superior spine of the ilium. 18. Poupart's ligament. 19. The iliacus muscle below Poupart's ligament. 20. The psoas muscle in the thigh. 21. The pectineus muscle. 22. The adductor longus. 23. The gracilis muscle. 24. The sartorius. 25. The upper part of the rectus. 26. The tensor vaginæ femoris muscle. 27. The anterior border of the gluteus medius. 28. The quadratus lumborum muscle of the left side. 29, 29. The intertransversales muscles of the lumbar vertebræ. 30. The divided edge of the anterior lamella of the transversalis muscle. 31, 31. The divided edges of the external oblique, internal oblique, and transversalis muscles of the left side. 32. The iliacus internus muscle. 33. The anterior surface of the sacrum. 34, 34. Part of the levator ani muscle at each side. 35. The symphysis pubis. 36, 36. The spermatic cords of the testicles. 37. The lower edge of the aponeurosis of the external oblique muscle turned aside. 38, 38. The fascia lata of the left thigh.
- A. The first lumbar nerve.
- a. The branch of communication from the last dorsal, dorsi-lumbar nerve. b. The branch of communication to the second lumbar nerve. c, c. The external or superior musculo-cutaneous nerve (ilio-scrotal, ilio-inguinal): the same nerve is seen issuing from beneath the psoas magnus muscle on the right side. d. Its muscular branch, divided. e, e. Its scrotal branch. f, f. The internal or inferior musculo-cutaneous nerve. g. Its branch of distribution to the groin and scrotum on the right side.
- B. The second lumbar nerve.
- h. Filaments which it receives from the second lumbar ganglion of the sympathetic. i. The branch of communication with the third lumbar nerve. k, k. The external cutaneous nerve (inguino-cutaneous). l, l. The same nerve on the outer side of the thigh. m, m. The external pudic nerve (n. spermaticus externus, pudendus externus, genito-cruralis). n. Its spermatic branch. o. Its crural branch.
- C. The third lumbar nerve.
- p. Filaments from the second lumbar ganglion of the sympathetic. q. A branch of communication with the fourth lumbar nerve. r. The large trunk formed by the union of branches from the first, second, and third nerves, descending to join the fourth lumbar nerve. s, s. Muscular branches.
- D. The fourth lumbar nerve.
- t. Filaments of communication with the third lumbar ganglion of the sympathetic. u. A branch of communication with the fifth lumbar nerve. v. A branch which unites with a corresponding branch from the third to form the obturator nerve.
- E, E. The obturator nerve (n. obturatorius). F, F. The crural nerve (n. femoralis).
- w, w. Muscular branches to the iliacus and psoas muscles. x, x. Its superficial, or cutaneous branches. y. Its muscular branches. z. Its saphenous branches.
- G. The fifth lumbar, or lumbo-sacral nerve, descending to join the sacral plexus.
- a*. Filaments from the communicating branch between the third and fourth lumbar ganglia of the sympathetic.
- H. The gluteal nerve (n. gluteus superior). I, I. The sacral plexus formed by the union of the lumbo-sacral with the four upper sacral nerves.
- b*, b*. Filaments of communication from the sacral ganglia of the sympathetic. c*, c*. Visceral branches divided.
- K, K. The fifth sacral nerve. S, S. The sympathetic nerve, its lumbar and sacral portions.
- d*. Its terminal ganglion, ganglion impar (g. azygos).
- L. A muscular branch from the last dorsal nerve.

internal cutaneous and ulnar nerves. The median nerve inclines outwards at first, in order to come into contact with the coraco-brachialis muscle. Towards the middle of the arm it crosses the brachial artery, usually in front, occasionally behind it, and becomes placed at its inner side, resting on the brachialis anticus. At the bend of the elbow the nerve sinks deeply into the interval between the pronator teres and the supinator longus muscles, and passes between the two heads of the pronator teres, and beneath the upper border of the flexor sublimis. Continuing its course along the fore-arm, the nerve lies between the muscle last named and the flexor profundus, with which it passes behind the annular ligament of the wrist, and so reaches the palm of the hand, where it divides into five branches.

The *first digital* branch proceeds outwards and forwards, lying upon the abductor and short flexor of the thumb, to both of which it gives filaments. It thus reaches the radial border of the thumb, and passes along its phalanges to their extremity.

The *second* branch is also intended for the thumb, being placed parallel with the preceding at its ulnar margin.

The *third*, larger than the preceding, sometimes forms, at its commencement, a common trunk with them. It proceeds directly forwards, giving some filaments to the abductor indicis, and one to the first lumbricalis muscle, and finally runs along the radial border of the phalanges of that finger.

The *fourth* branch, still larger, corresponds in its course with the second metacarpal space, where it gives a ramusculus to the second lumbricalis muscle, and finally divides into two collateral branches of equal size, which supply the adjacent borders of the fore and middle fingers.

The *fifth* digital branch lies in the third metacarpal space, where it communicates by a transverse slip with the ulnar nerve (its second digital branch). Like the fourth, it divides into two branches, which are placed along the contiguous margins of the middle and ring fingers.

In the arm the median nerve communicates with the musculo-cutaneous, and gives only a very few muscular branches, which are so small as scarcely to deserve notice; they are distributed to the muscles arising from the inner condyle of the humerus, opposite which they are given off. The most remarkable of these is the inter-osseous nerve (plate XVIII. fig. 2, e; *n. inter-osseus anticus*). This is of considerable size; immediately after its origin it passes backwards to reach the anterior surface of the interosseous ligament, where it comes into contact with the artery of the same name. In this situation, the nerve is interposed between the flexor profundus and flexor pollicis longus, and so continues, as far as the upper border of the pronator quadratus muscle. Having passed under cover of the muscle just named, to which it gives some small filaments, the nerve turns backwards through the interosseous ligament, and so gains the dorsal surface of the hand, where it ramifies in several filaments.

At the lower part of the fore-arm, another branch is given off, called, from its ultimate destination, the *cutaneous palmar* branch (plate XVIII. fig. 1, i; fig. 2, f). This descends between the flexor tendons, passes in front of the annular ligament and palmar fascia, and divides into filaments, which supply the skin at the centre of the palm of the hand.

Musculo-spiral nerve.—The musculo-spiral nerve (plate XVII. F; plate XVIII. A: *nervus radialis*, Scæmm.; *nerf radio-digital*, Chauss.) is, at first, the largest of those which issue from the plexus. Its direction is downwards, backwards, and outwards, winding in a spiral manner round the bone, whence its name is derived. It lies in the cellular interval between the short and middle heads of the triceps muscle, accompanied by the superior profunda, or spiral artery. But, in order to reach the external and anterior aspect of the humerus, where it finally appears, the nerve passes between the second head of the muscle and the bone, lying in a canal formed for it by some tendinous fibres, which arch obliquely over it. The nerve (plate XVIII. fig. 2, A), in the next place, lies deeply in the interval between the brachialis anticus and supinator longus, which overlap and conceal it, until it reaches the elbow-joint. There it divides into two primary branches, one being placed on the anterior and external part of the fore-arm, the other lying deeply at its posterior aspect.

The *anterior branch* (plate XVIII. fig. 2, a) resembles the continuation of the nerve in direction, though not in size. It proceeds directly downwards, guided by the supinator longus, giving several branches, usually five or six, which are distributed to the extensor and supinator muscles. In the middle third of the arm, the nerve, considerably reduced in size, comes into relation with the radial artery, and lies to its outer side for some way. After a while it inclines outwards, beneath the tendon of the supinator longus, to reach the external border of the fore-arm (plate XIX. fig. 1, g; fig. 2, e), upon which it descends, lying superficial to the extensors of the thumb. Near the carpus it divides into two, or sometimes into three branches. One of these (fig. 1, h) runs along the radial border of the thumb, forming its first posterior collateral branch. Another (fig. 1, i) corresponds with the first

metacarpal space, and divides, for the supply of the ulnar border of the thumb and the adjacent border of the fore-finger. The third, after having given a branch from its ulnar side, which supplies the contiguous borders of the ring and middle fingers, proceeds forwards in the second metacarpal space, and divides into two collateral branches for the supply of the index and middle fingers (their adjacent borders). This branch of the spiral nerve will thus supply, besides the thumb, both sides of the index and middle fingers, and one side of the ring finger. In some cases, both sides of the latter receive their nerves from the ulnar, and, occasionally, its radial collateral branch is derived from an interlacement formed by the ramifications of the ulnar and spiral nerves.

The *branches* of the spiral nerve are numerous. Two or three, of considerable size, are given to the triceps, whilst the nerve is in contact with it. One of these ultimately becomes cutaneous, and is sometimes called *nervus cutaneus externus superior* (plate IX. fig. 1, d). It ramifies for some way in the integument covering the external and posterior part of the arm, and even of the fore-arm, where it communicates with the branches of the proper external cutaneous nerve. Then it gives the different muscular branches above mentioned to the supinators and extensors on the outer border of the fore-arm, and in the same situation its deep-seated branch. This branch (plate XVIII. fig. 2, b; plate XIX. fig. 2, b: *ramus profundus*, vel *muscularis*,) is larger than the continuation of the nerve. It inclines outwards as it descends, and after having passed beneath the supinator longus and the two radial extensors, pierces the substance of the supinator brevis, giving it several filaments. On arriving at the lower border of that muscle, the nerve gives off several branches, some being distributed to the long extensors of the fingers, others to those of the thumb. Finally, one rather remarkable by its size and regularity, (plate XIX. fig. 2, c; *ramus inter-osseus posticus*,) passes along the deep-seated muscles (the extensors of the thumb and index finger), distributes branches to them, and extends as far as the carpus, ramifying on its posterior aspect.

Intercosto-humeral nerves.—The superior extremity, in addition to the several nerves thus derived from the brachial plexus, receives three long branches, which come from the first, second, and third intercostal nerves. The branch derived from the first intercostal nerve passes out between the first and second ribs, and after giving filaments to the skin at the axilla, runs a little way in the integument of the inner and upper part of the arm.

The branch from the second intercostal nerve (plate XVII. x) passes out from the second intercostal space, gives a filament or two which turn forwards to the skin upon the front of the chest, and after communicating with the first perforating branch just noticed, and the third which lies beneath it, as well as with the internal cutaneous nerve, it gives branches to the skin of the axilla, and terminates along the inner side of the arm. The branch from the third intercostal nerve (plate XVII. y), after piercing the muscles, gives filaments to the tegument below the axilla and along the lower border of the scapula. The origin and termination of these nerves are briefly indicated by the name given to them—"intercosto-humeral."

Dorsal nerves.—The dorsal nerves (*nervi dorsales*, v. *intercostales*) consist of twelve pairs; the first issues through the intervertebral foramen, between the first and second dorsal vertebræ, the last between the twelfth and the first lumbar. The part of the spinal cord with which the cervical nerves are connected being nearly opposite the inter-vertebral foramen which gives them exit, the roots proceed almost horizontally outwards; those of the dorsal region, on the contrary, proceed obliquely downwards to leave the canal; and the degree of obliquity gradually increases from above downwards, so that the last deviates from the horizontal direction more than any of those above it. In size they are less than the inferior cervical, the lumbar, and the greater number of the sacral: this, doubtless, is owing to the parts to which the dorsal nerves are distributed (the parietes of the thorax and abdomen) being less in extent than the upper and lower extremities, to which the others are given. Immediately after leaving the intervertebral foramina, they divide, as was described in treating of the cervical nerves, into posterior and anterior branches.

The posterior branches (plate XX. fig. 1, c, c; *rami dorsales*, vel *postici*) pass backwards between the transverse processes, and are distributed to the dorsal muscles, some ramifying close to the spine, others near the angles of the ribs. This difference of distribution has given rise to these branches being considered divisible into an internal and an external series; both supply the erector spinæ and superficial muscles, namely, the rhomboidei, trapezius, and latissimus dorsi, and send filaments also to the integuments.

The anterior branches (plate XX. fig. 1, a, a; *rami intercostales*) follow the intercostal spaces, lying, in the first instance, near the lower margin of the rib above them, but as they advance they gradually descend, and approach the inferior one, in this respect corresponding with the intercostal

arteries which they accompany. Immediately after their commencement, the anterior branches communicate, each by one or two small filaments, with the neighbouring ganglion of the sympathetic nerve. Proceeding outwards, they at first lie between the pleura and external intercostal muscles; towards the angles of the ribs they pass between the two layers of intercostal muscles, furnishing them with several filaments, and at length each gives a large superficial branch (fig. 1, f, f). This is given off at about half the length of the intercostal space; or, as this does not apply except in the superior nerves, it will be more correct to state the point to be midway between the spine and the median line in front.

The further distribution of the nerves presenting some peculiarities in several, it is necessary to describe them specially.

The anterior division of the first nerve sends upwards over the head of the first rib a large branch (plate XVII. e) to join with the brachial plexus. The continuation of the intercostal nerves in the first seven spaces, that is to say, those which lie between the true or sternal ribs, after giving off each a superficial branch, pursue their original course forwards to the sternum, furnishing twigs to the intercostal muscles and triangularis sterni; and finally piercing them, they ramify in the pectoralis major and the integuments in the neighbourhood of the sternum. The four following intercostal nerves being those which correspond with the false or asternal ribs, after having furnished their superficial branches, approach the anterior extremity of the intercostal spaces, pass over the costal attachment of the diaphragm, and advance between the transversalis and obliquus internus abdominal muscles; to these they supply numerous twigs, and finally terminate in the substance of the rectus and the integuments covering it.

The superficial or external branches of the first, second, and third nerves pass across the axilla, and ramify in the integuments of the arm on its inner and posterior aspect; the former communicates with the internal cutaneous nerve. These are the *intercosto-humeral* branches (plate XVII. x, y). The corresponding branches (plate XX. fig. 1, f, f; fig. 2, a, a) of the dorsal nerves, from the fourth to the eleventh inclusive, pass through the external intercostal muscles, and are distributed to the superficial muscles of the thorax and abdomen; the superior supplying the pectoral muscles and the mamma, those lower down the serratus magnus and the external oblique abdominal muscles; and all send filaments to the integuments.

The anterior branch of the twelfth dorsal nerve, passing below the last rib, cannot be named intercostal. At its commencement it sends a communicating branch to the first lumbar nerve (plate XXI. a; *dorsi-lumbar*); it then passes outwards, inclining obliquely down from the last rib, and lies in front of the quadratus lumborum. Near the outer margin of the last-named muscle, this nerve divides into deep and superficial branches, which are disposed in the same manner as those above it: thus the deep-set ramify between the transversalis and internal oblique muscles, and end in the

PLATE XXII.

The branches of the sacral plexus, as they are seen issuing from the openings on the posterior aspect of the pelvis. The gluteus maximus and medius muscles have been removed, as have also the origins of the latissimus dorsi and erector spinæ from the sacrum.

No. 1. That portion of the external surface of the ilium to which the gluteus medius was attached. 2. The posterior superior spinous process of the ilium. 3. Its posterior inferior spinous process. 4, 4. The posterior sacro-iliac ligaments. 5. The posterior surface of the sacrum, upon which the posterior sacral foramina are seen, giving exit to the posterior sacral nerves. 6. The coccyx. 7. The gluteus minimus muscle. 8. The pyriformis muscle. 9. The gemellus superior muscle. 10. The obturator internus muscle. 11. The gemellus inferior muscle. 12. The quadratus femoris muscle. 13. The tuberosity of the ischium. 14. The great or posterior sacro-ischiadic ligament. 15. The spine of the ischium. 16. The fibres of origin of the obturator internus muscle. 17. The ramus of the ischium and pubis. 18. The gracilis muscle. 19. The semi-tendinosus muscle. 20. The long head of the biceps muscle. 21. The upper part of the adductor magnus muscle. 22. The vastus externus muscle. 23. The trochanter major of the femur.

A, A. The posterior branches of the sacral nerves. B. The gluteal nerve (n. gluteus superior).

a. Its ascending branch. b. Its descending branch. c. Branches distributed to the gluteus maximus muscle.

C, C. The internal pudic nerve (n. pudendus).

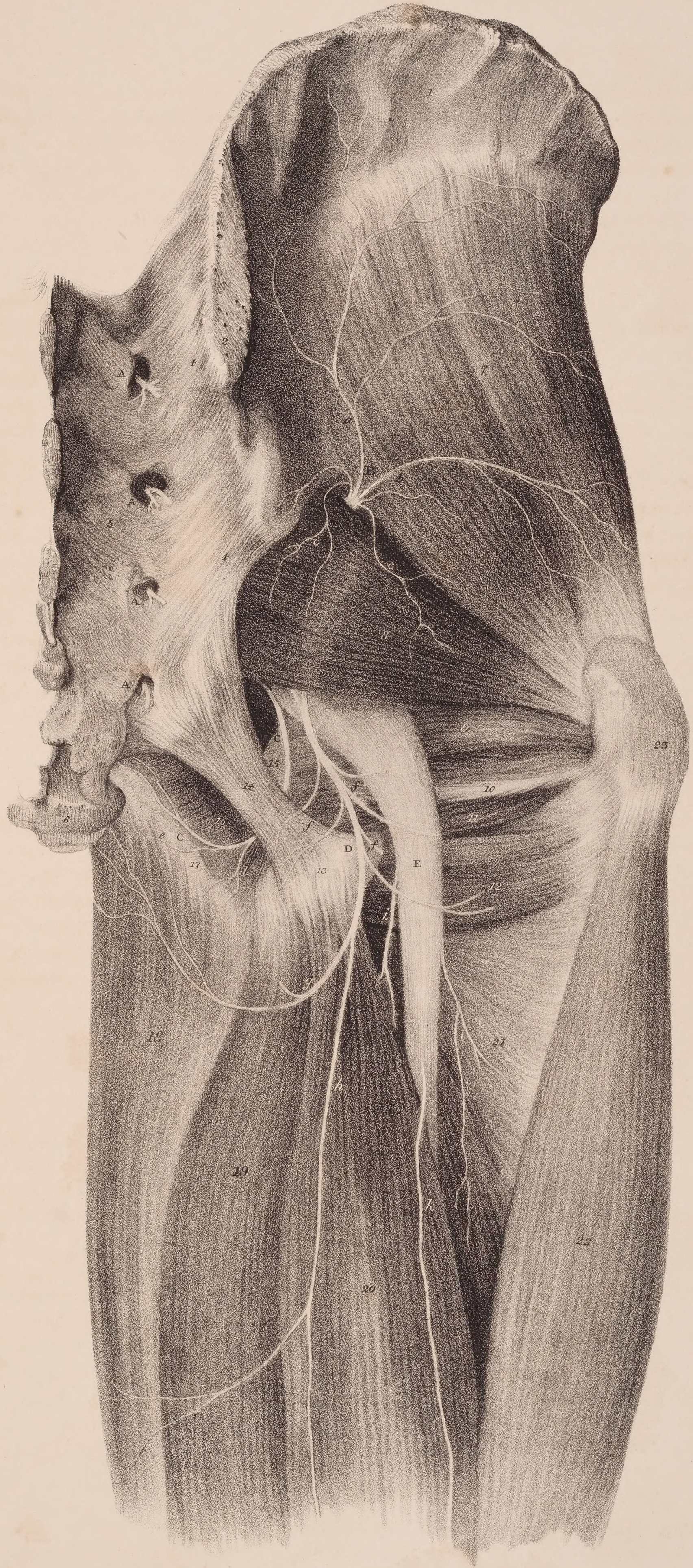
d. External hæmorrhoidal branch (n. hæmorrhoidalis inferior). e. The perineal branch (n. pudendus inferior.)

D. The small sciatic nerve (n. ischiadicus minor, vel gluteus inferior).

f, f. Inferior gluteal branches. g. The posterior and internal cutaneous nerve. h. The middle posterior cutaneous nerve.

E. The great sciatic nerve (n. ischiadicus).

i, i. Muscular branches. k. Cutaneous branch, one of the posterior external cutaneous nerves.





rectus; while the superficial proceed along between the two superficial muscles, in which and the integuments they are expended.

Lumbar nerves.—The nerves which communicate the power of sensation and motion to the lower extremity, are derived from the lumbar and sacral plexus, that is, from a net-work or interlacement which the anterior branches of the lumbar and sacral nerves form, after they have passed out of the spinal canal. As the entire of these nerves maintain thus an uninterrupted communication at their origin, and are distributed to similar structures, they have been associated under the general name “lumbo-sacral” plexus. This union resembles that which exists between the cervical and brachial plexus, being perhaps even more intimate.

The lumbar nerves, (*nervi lumbales*), five in number, arise from the medulla spinalis by double roots. These, before uniting at the inter-vertebral foramen, proceed in a very oblique course, the last approaching to the vertical direction. Though exceedingly close, as it were compressed together within the spinal canal, the roots of different pairs have no communication one with the other; they form part of what is named the “cauda equina” of the spinal cord. The trunks formed by the union of each pair of roots pass through the inter-vertebral foramina, the first being transmitted through that between the first lumbar vertebra and the second, the fifth through that between the last and the sacrum. These trunks are very short, being not more than a few lines in length, as they immediately divide into two branches, called, from their direction, anterior and posterior.

The *posterior* branches of the lumbar nerves (*rami postici*, vel *dorsales*) pass backwards, immediately after their division, between the transverse processes of the vertebræ, and are distributed to the deep-seated extensor muscles situated along the spine, some of their branches (plate XX. fig. 2, c, c) extending as far as the skin. It may be observed, that they diminish gradually in size from the first to the last.

The *anterior* branches of the lumbar nerves (*rami lumbales*) increase in size from above downwards, and inclining outwards as they descend, become mutually connected by communicating filaments, sent from one to the other.

Lumbar plexus (plate XXI.)—By the union in the way here indicated of the anterior branches of the first four lumbar nerves, A, B, C, D, (that of the fifth going to join the sacral,) a plexus or interlacement is formed (*plexus lumbalis*) reaching from the second to the fourth lumbar vertebra, resting on the junction of the transverse processes with their bodies, and covered by the psoas muscle. In addition to this mutual communication, each nerve receives one or two small filaments from the lumbar ganglia of the sympathetic nerve (n, p, t, a*). The plexus is moreover brought into relation

PLATE XXIII.

In this plate are shown the nerves which are distributed on the anterior and inner aspect of the thigh. The sartorius and part of the adductor longus muscle have been removed in order to bring the deep-seated nerves more clearly into view.

No. 1. The rectus muscle. 2. The edge of the tensor vaginæ femoris muscle. 3. The anterior superior spinous process of the ilium. 4. The upper part of the sartorius muscle. 5. The iliacus muscle. 6. The psoas muscle. 7. The aponeurosis of the external oblique muscle of the abdomen. 8. The external abdominal ring. 9, 9. The femoral artery. 10, 10. The profunda artery. 11. Its external circumflex branch. 12. The femoral vein. 13. The termination of the internal saphenous vein in the femoral vein. 14. The pectineus muscle. 15. The adductor brevis muscle. 16. The tendon of origin of the adductor longus muscle. 17. The lower portion of the adductor longus muscle. 18. The adductor magnus muscle. 19. The gracilis muscle. 20. The vastus internus muscle. 21. The patella. 22. The ligamentum patellæ. 23. The expansion of the tendon of the sartorius muscle. 24. The lower part of the sartorius muscle. 25. The tendon of the gracilis muscle. 26. The tendon of the semi-tendinosus muscle. 27. The fascia covering the gastrocnemius muscle.

A. The external cutaneous nerve, escaping from beneath Poupart's ligament to gain the outer side of the thigh.

B. The crural nerve (*nervus femoralis*).

a, a. Its anterior cutaneous branches. b. An anterior cutaneous branch piercing the rectus muscle to reach the integument. c, c. Muscular branches. d. A large muscular branch distributed to the vastus internus muscle. e, e. The short saphenous nerve. f, f. The long or internal saphenous nerve (*nervus saphenus major*, vel *internus*). g. The internal saphenous nerve passing between the tendons of the sartorius and gracilis. h, h. Branches of the internal saphenous nerve distributed to the knee-joint and to the integument about the knee. i, i. Anterior branches of the obturator nerve distributed to muscles. k. A long descending branch of the obturator nerve communicating with the internal saphenous nerve. l, l. Branches of the obturator nerve descending behind the adductor brevis muscle. m, m. Cutaneous filaments of the obturator nerve.

with the dorsal nerves by a branch (a) which the last dorsal sends down to the first lumbar, and also with the sacral nerves by the fifth lumbar (G), which becomes associated with them. As the latter communicating branch, which is of considerable size, has been named *lumbo-sacral*, the former, though very small and delicate, may with equal propriety be termed *dorsi-lumbar*.

The lumbar plexus thus constituted gives off the following branches, which, if taken in the order of their origin, from above downwards, may be thus arranged: the musculo-cutaneous, external cutaneous, external pudic, the crural and obturator nerves, and lastly the lumbo-sacral or communicating branch.

The *musculo-cutaneous* branches (plate XXI. c, f) are usually two in number, and are derived either from the first lumbar nerve, or in some cases from the filament sent from it to the second. Both pass downwards and outwards through the upper part of the psoas muscle, supported on the quadratus lumborum, to the posterior part of the crista ilii. While in the lumbar region these branches run parallel, one being placed a little superior and external to the other. 1. The *external* branch (c; *ilio-scrotal*, or *ilio-inguinal*), on reaching the posterior part of the crista ilii, gets between the transversalis and internal oblique muscles, and divides into two ramusculi, one of which (plate XX. fig. 2, e), after giving some twigs to the transversalis and iliacus, pierces the abdominal muscles, becomes subcutaneous on the posterior part of the ilium, and is distributed to the skin over the gluteus medius and maximus. The other (plate XXI. d, e) proceeds obliquely forwards and inwards, as far as the anterior superior spine of the ilium, and then takes the direction of the crural arch. On reaching the abdominal ring, it passes outwards, together with the spermatic cord, to which it distributes several filaments; some also reach the skin of the scrotum, others that on the pubes and labia in females. The distribution of the branches of this nerve indicates the propriety of the names applied to it, viz. *ilio-scrotal*, or *ilio-inguinal*. 2. The second, or more *internal* branch (plate XXI. f, g), after descending a little, lies on the fascia iliaca, covered by the peritonæum. After running for a while parallel to, and within half an inch of the crista ilii, it passes through the fibres of the transversalis, and so is placed between that muscle and the internal oblique, and soon after between the latter and the external oblique. To these muscles it gives delicate branches, and terminates by sending two or three which ramify on the integument of the groin and scrotum, communicating with the other cutaneous branches in these structures.

The *external cutaneous* branch (plate XXI. k, k; *inguino-cutanée*, Chauss.), proceeding from the anterior branch of the second, or from that between it and the third lumbar nerve, passes through the psoas muscle on a level with the crista ilii, runs from thence downwards and a little outwards, lying on the fascia iliaca. On reaching the anterior superior spinous process of the ilium, it emerges from the pelvis (l), by passing through the interval between that process of bone and the inferior one; after which the nerve divides into two ramusculi, which separately pierce the fascia lata of the thigh, and proceed to different destinations. 1. One of these inclines backwards, and, becoming subcutaneous, runs over the tensor vaginæ muscle, and along the external part of the thigh, placed between the fascia and the integuments, distributing filaments as it descends, until it ceases to be discernible about the union of the middle with the lower third of the thigh. 2. The *anterior* branch pierces the fascia from an inch and a half to two inches below the anterior superior spine of the ilium, becoming also subcutaneous, and ramifies as far as the external side of the knee, in numerous delicate filaments, which will be found on the fascia covering the vastus externus muscle.

The *external pudic* branch (plate XXI. m, m: *nervus spermaticus externus*, Scœmm.; *pudendus externus*; *genito-cruralis*) arises from the second lumbar nerve, or from the communicating branch between it and the first, pierces through the fibres of the psoas muscle and the fascia that covers it, and then runs vertically downwards, lying on the anterior surface of that muscle. In this course it is covered by the peritonæum, and, on approaching the crural arch, it divides into two ramusculi, one being internal, the other external in its direction. 1. The *internal* ramusculus (n), somewhat larger and longer than the other, turns forwards a little, so as to come into contact with the spermatic cord, or round ligament, which it accompanies through the abdominal ring, being distributed to the cremaster muscle and the investments of the testis in the male, some of its filaments extending also to the neighbouring parts of the groin, and in the female to the labia and pubes. 2. The *external* branch (o) inclines outwards in front of the external iliac vessels, just at their termination, passes beneath the crural arch, and divides into several filaments, which ramify in the inguinal region and in front of the thigh, some of them becoming subcutaneous.

The *crural nerve* (plate XXI. F, F; plate XXIII, B: *nervus femoralis*; *femoro-præ-tibialis*) arises from the second, third, and fourth lumbar nerves, the greater part being derived from the two

last ; in some instances, also, it receives a small filament from the first, or from the communicating branch that passes between it and the second. The nerve thus formed is of considerable size, and is situated at first deeply in the sulcus between the contiguous margins of the psoas and iliacus muscles. As it descends it comes forwards somewhat, so as to become apparent, though it still remains covered by the fascia iliaca, and is guided to the crural arch by the psoas muscle (its external border), which separates it from the iliac artery. In this course the nerve gives from its external side several small filaments to the iliacus muscle ; internally, some also pass over the iliac vessels, and others to the psoas muscle. Amongst the latter, one may be observed to take a retrograde course, running from below upwards on the muscle. Close to Poupart's ligament, or immediately after it has passed beneath it, the anterior crural nerve spreads out and divides into a lash of branches, which diverge to their different destinations, and may be divided into a superficial and deep set, the former piercing the fascia, and becoming subcutaneous, forming the cutaneous nerves of the anterior and inner parts of the thigh, the latter remaining covered by that membrane.

The *superficial* branches are very slender, and usually two in number (plate XXI. x, x ; plate XXIII. a, a), sometimes there are more. They pierce the fascia from half an inch to an inch below Poupart's ligament, one just in front of the femoral artery, the other about midway between that point and the external border of the thigh. These may be called the anterior cutaneous branches, to distinguish them from the external cutaneous nerve and its branches, already described. One of these cutaneous branches passes down beneath the integument, lying on that part of the fascia which covers the rectus muscle, and may be traced as far as the front of the knee. The other runs more internal, distributing filaments as it descends over the sartorius and vastus internus, as far as the inner side of the knee-joint.

The *deep-seated* branches of the anterior crural nerve are very numerous, and admit of being divided into an external, internal, and long or descending set. The long descending branches are two in number (plate XXI. z) ; they both incline inwards as they descend, and come into contact with the sheath of the femoral vessels, where they are crossed by the sartorius muscle. One of these (plate XXIII. e, e) lies along the external side of the sheath of the vessels for some way, and distributes filaments to the sartorius as it descends ; it soon, however, inclines outwards, and ramifies in the vastus internus as far as the knee. The other branch (f, f ; *nervus saphenus major, vel internus ; tibio-cutané*, Chauss.) is larger and much longer than the preceding. It inclines inwards to get upon the sheath of the vessels ; it then runs under cover of the fascia extended from the adductors to the vastus internus, and lies for about the middle third of the thigh towards the superior and external side of the artery. When the artery is about to pass backwards into the popliteal space, the nerve ceases to accompany it, and continues its course directly down to the knee, covered by the sartorius, to which it gives some filaments. Opposite the inner condyle, the saphenous nerve may be found between the tendons of the sartorius and gracilis muscles (plate XXIII. g). In this situation the nerve becomes subcutaneous, and applies itself to the saphenous vein, which it accompanies along the anterior and inner side of the leg, distributing filaments to the integuments as it descends. It passes with the vein in front of the inner ankle, and ramifies by several minute filaments upon the dorsum of the foot. At its origin, this nerve receives a branch of communication from the obturator. In its course along the thigh it is the collateral or satellite nerve of the femoral artery ; and in the leg, of the saphena vein.

The rest of the deep-seated branches (plate XXI. y ; plate XXIII. c, c) are distributed almost exclusively to the muscles of the thigh, and may, as we have said, be divided (from a consideration of their direction) into an external and an internal set. The *external* branches incline outwards in front of the iliacus and psoas muscles, gradually diverging as they proceed. They get under cover of the sartorius, and give off three or four filaments for its supply, some of which pierce the fibres of the muscle, and ramify on its anterior surface ; two of these, after piercing the sheath of the sartorius, become subcutaneous and reach as far as the patella. Other branches, still very numerous, pass beneath the rectus and tensor vaginae femoris, supplying both ; the remainder being distributed to the psoas and iliacus muscles after their junction, and finally to the two vasti and the crureus. The *internal* set of branches, not so large or so numerous, incline inwards beneath the femoral vessels, and supply the pectineus and adductor longus.

The *obturator nerve* (plate XXI. E, E ; *nervus obturatorius, sub-pubio-femoralis*) arises from the third and fourth lumbar nerves, and is smaller than the crural nerve, from which it is separated by the breadth of the psoas muscle, one running along its external border in the iliac fossa, the other placed beneath its inner margin, along the brim of the pelvis. In this course the nerve lies between

the peritonæum and the pelvic fascia, being situated about half an inch above the obturator artery, (when it arises from the internal iliac,) but gradually descends, so as to come into contact with it as they approach the obturator foramen, through which they pass out from the pelvis to reach the upper part of the thigh. Whilst within the pelvis, it gives off no branches: as it passes out of the foramen, it gives two offsets to the external obturator muscle, of which one enters its upper border, the other its anterior surface. From this a filament inclines outwards to the cotyloid notch, through which it reaches the hip-joint. On reaching the thigh, the nerve lies deeply between the pectineus and obturator externus muscles, and divides into two branches, one lying on a plane anterior to the other, the adductor brevis being in fact interposed between them.

The *posterior*, or deep branch (plate XXI. l, l), passes backwards, descending behind the adductor brevis, and so reaches the anterior surface of the adductor magnus, to which it is distributed. The *anterior* branch (plate XXIII. i, i) will be observed to incline downwards and inwards between the pectineus and adductor brevis, and there divide into three offsets, which are distributed to the gracilis, and the long and short adductors. The branch to the gracilis inclines inwards, and runs for some way upon its inner surface before it terminates. The branch to the short adductor runs upon its anterior surface, and divides into filaments which penetrate its substance above its middle; from some of these an offset (k) usually passes to join the saphenous nerve. The branch to the adductor longus, after passing behind the muscle and giving it filaments, descends to the inner side of the thigh, gives a connecting branch to the saphenous nerve, and can be traced to the inner side of the knee, arising from the lumbo-sacral nerve as here indicated.

Lumbo-sacral nerve.—The lumbo-sacral, or communicating nerve, (plate XXI. G, G; *nervus lumbo-sacralis*,) is the last offset from the lumbar plexus, and in size is larger than either of the preceding nerves. It is made up of the whole of the anterior branch of the fifth pair, and of the connecting branch sent down from the fourth. It passes backwards in front of the sacro-iliac symphysis to reach the pelvis, where it joins the first sacral nerve, and so contributes to form the sacral plexus, at the same time that it forms the connecting link between it and the lumbar plexus. Before its termination it gives off the gluteal branch, which is the only one that arises from it.

PLATE XXIV.

The nerves of the anterior aspect of the leg are exhibited in this plate. In fig. 1, the superficial nerves distributed to the integument are seen resting on the deep fascia. In fig. 2, the fascia, with some of the muscles, have been removed to show the deep-seated nerves.

Fig. 1. a, a. The middle cutaneous nerves, branches of the anterior crural. b. The termination of one of the branches of the external cutaneous nerve.

A, A. The internal saphenous nerve.

c, c. Branches of the internal saphenous nerve distributed to the integument around the knee. d. The termination of the internal saphenous nerve on the inner side of the foot and great toe.

B. The musculo-cutaneous nerve piercing the deep fascia.

e. Its internal branch, supplying the great toe and the adjoining side of the second. f. The external branch, supplying the three outer toes and half the second. g. A cutaneous branch distributed over the external ankle.

C. The external saphenous nerve, ramifying on the outer border of the foot.

h. Its branch of communication with the external branch of the musculo-cutaneous.

D. The termination of the anterior tibial nerve, distributed upon the adjoining sides of the great and second toes.

Fig. 2. The deep fascia has been removed, together with the tibialis anticus and extensor proprius pollicis muscles from the front of the leg, and the peroneus longus from the outer side.

No. 1. The lower part of the vastus externus muscle. 2. The tendon of the rectus muscle. 3. The lower part of the vastus internus muscle. 4. The internal lateral ligament of the knee-joint. 5. The patella. 6. The ligamentum patellæ. 7. The tendon of the biceps muscle. 8. The origin of the peroneus longus muscle from the head of the fibula; the rest of the muscle has been removed. 9. The soleus muscle. 10. The peroneus brevis muscle. 11. The extensor communis digitorum muscle. 12. The interosseous membrane. 13. The tibia. 14. One belly of the gastrocnemius muscle. 15. A part of the soleus muscle. 16. The tendon of the tibialis anticus muscle. 17. The tendon of the extensor proprius pollicis muscle. 18. The anterior annular ligament. 19. The peroneus tertius muscle. 20. The lower part of the fibula. 21, 21. The extensor brevis digitorum muscle.

A. The peroneal nerve (*nervus peroneus*). B. The musculo-cutaneous nerve; a division of the peroneal nerve.

a, a. Muscular branches distributed to the muscles of the calf.

C, C. The anterior tibial nerve (interosseous nerve, *nervus tibialis anticus*).

b, b. Its muscular branches. c, c. Branches distributed to the joints of the foot. d, d. Branches distributed to the extensor brevis digitorum muscle. e, e. Interosseous branches. f. The termination of the anterior tibial nerve.

Fig. 1.



Fig. 2.





The *gluteal* nerve (plate XXI. H ; plate XXII. B : *nervus gluteus superior*) turns outwards beneath the border of the sciatic notch, and above the pyriformis muscle. On reaching the exterior of the pelvis, the nerve immediately divides into filaments, which ramify over the dorsum ilii, supplying the two deep-seated gluteal muscles.

Sacral nerves.—The sacral nerves, five, and not unfrequently six in number, arise from the extremity of the medulla spinalis, which, it may be observed, ceases in the adult subject opposite the second lumbar vertebra. The fasciculi which compose the roots of these nerves must therefore descend almost vertically in the sacral canal, to reach the foramina through which they are transmitted ; and as they are divided into a number of filaments, proceeding from a root or common point of attachment, they assume that peculiar appearance which has given rise to the term *cauda equina*, usually applied to them with the lower lumbar nerves, which present a like disposition, though in a less marked degree. While yet within the sacral canal, the two roots by which each nerve arises unite to form a common trunk, which soon divides into two branches that take quite an opposite course, one being directed backwards, the other forwards.

The *posterior* branches (plate XXII. A, A) of the four superior sacral nerves, like those of the lumbar set, are much smaller than the anterior. They pass backwards through the posterior sacral foramina, penetrate the tendinous origin of the sacro-lumbalis muscle, to which they distribute filaments in their passage, and become subcutaneous. Each of these branches inclines outwards, lying on the fascia that covers the gluteus maximus muscle, and is finally distributed to the skin covering the nates. The posterior branches of the two last sacral nerves are much smaller than any of the others ; they pass downwards and forwards to supply the integuments round the margin of the anus. These several nerves have for the most part a communication from one to the other, each being connected with that which precedes and follows.

The *anterior* branches (plate XXI. ; *rami antici*) of the sacral nerves diminish in size from above downwards. They issue from the spinal canal through the anterior sacral foramina, and immediately each communicates with the neighbouring pelvic ganglion of the sympathetic nerve. The first three sacral nerves passing outwards and uniting with the communicating branch sent down from

PLATE XXV.

In this plate are shown the superficial and deep nerves of the posterior aspect of the leg.

Fig. 1. The deep fascia has been left, covering in the muscles, excepting in the popliteal region, where a small portion has been removed, together with the cellular tissue and fat, in order to bring into view the popliteal nerve.

Nos. 1, 1. The divided edges of the popliteal fascia. 2. Part of the inner head of the gastrocnemius muscle. 3, 3. Convexities formed by the gastrocnemius muscle. 4. The tendo Achillis seen through the fascia. 5. The internal malleolus. 6. The external malleolus.

a, a. Posterior cutaneous nerves, branches of the sciatic nerves.

A. The popliteal nerve (n. popliteus).

b. A branch of the popliteal nerve ; the nervus cutaneus longus posterior, vel communicans tibiæ.

B. The fibular nerve (n. peroneus).

c. The communicans fibulæ. d, d. The external saphenous nerve formed by the union of the communicans tibiæ with the communicans fibulæ. e, e. Branches distributed to the outer ankle and outer border of the foot. f. The internal saphenous nerve piercing the fascia and becoming superficial. g. Cutaneous branches to the integument of the calf. h, h. Branches to the inner ankle and side of the heel.

Fig. 2. The superficial layer of muscles has been removed, in order to bring into view the deep layer, and the course and distribution of the posterior tibial nerve.

No. 1. The biceps muscle. 2. The semi-tendinosus. 3. The semi-membranosus muscle. 4. The gracilis muscle. 5. The edge of the sartorius. 6, 6. The divided heads of the gastrocnemius muscle. 7. The ligamentum posticum Winslowii. 8. The popliteus muscle. 9. The upper extremity of the fibula. 10. The peroneus longus muscle. 11. The peroneus brevis. 12. The flexor longus pollicis muscle. 13, 13. The tibialis posticus muscle. 14. The flexor longus digitorum muscle. 15. The inner malleolus. 16. The tendon of the tibialis posticus muscle. 17. The tendon of the flexor longus digitorum. 18. The posterior tibial artery. 19. The tendon of the flexor longus pollicis muscle. 20. The tendo Achillis divided.

A, A. The popliteal nerve (n. popliteus).

a, a. Its muscular branches. b. The communicans tibiæ branch cut across.

B, B. The posterior tibial nerve (n. tibialis posticus).

c, c. Its muscular branches.

C. The fibular nerve (n. peroneus).

d. The communicans fibulæ branch, divided. e. The point at which the fibular nerve passes beneath the head of the peroneus longus muscle. f. A muscular branch from the fibular nerve.



Fig. 1

W. J. E. Wilson, direct.



Fig. 2.

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the fourth and fifth lumbar nerves, and having received some branches from the fourth sacral, form the sacral plexus, not as in other instances, by sending fasciculi from one to the other, so as to constitute an interlacement, but by a union of their fibres, forming a large compressed cord, from which nerves are given off. The anterior branch of the fourth sacral nerve, after passing through the fourth sacral foramen, communicates by a filament with the sympathetic, and gives some offsets, which, with similar branches from the third, go to the hypogastric plexus. It sends some filaments to the levator ani and coccygeus muscles, after which it terminates in the skin about the anus, and in the sphincter ani. The anterior branches of the fifth and sixth sacral nerves are very small, and do not enter into the formation of the plexus: they pass forwards, the first between the sacrum and coccyx, the second in a notch on the side of the latter, and are distributed to the muscles in their immediate neighbourhood, namely, the sphincter ani and coccygeus.

The *sacral plexus* (plate XXI. I; plexus sacralis, vel ischiadicus), formed as above stated, is situated deeply at the posterior and lateral part of the pelvis, resting on the surface of the pyriformis muscle, crossed by some of the branches of the internal iliac artery, and covered (particularly at the left side) by the rectum.

The branches of the sacral plexus may be divided into two sets, one internal, the other external: the former (plate XXI. c*, c*) consisting of the hæmorrhoidal, vaginal, uterine, vesical, and pudic, are distributed to the parts in the pelvis and perinæum; the latter, intended for the supply of the lower extremity, are two in number, and are named the small and the great sciatic nerves.

The hæmorrhoidal nerves (*nervi hæmorrhoidales superiores*) pass forward to the lower part of the rectum, and ramify in its muscular coat and mucous lining membrane, from the sphincter upwards to a considerable distance. These nerves interlace with branches of the sympathetic, and communicate with the vesical and vaginal nerves, which occasionally are even given off altogether from them.

Vaginal and uterine nerves.—Several slender twigs pass forward by the side of the rectum, and are distributed to the vagina; a few ascending reach the lower part of the uterus, anastomosing with the numerous branches of the sympathetic nerve supplied to that organ.

The vesical nerves, frequently confounded at their commencement with the two preceding series, proceed forwards to the lower part of the bladder, and ramify in its two internal coats. In their course they furnish twigs to the vesiculæ seminales and prostate gland in the male, and the urethra in the female.

The pudic nerve, (plate XXII. C, C; *nervus pudendus*,) is derived principally from the third sacral; it inclines downwards and outwards from the plexus, so as to come into contact with the pudic artery as it is escaping from the pelvis, in the interval between the pyriformis and coccygeus muscles. Its course and distribution are similar in every respect to that of the artery. In company with it, the nerve returns to the pelvis through the small sciatic foramen, and gives off a superficial branch (e: perinæal nerve; n. pudendus inferior). This long branch, ascending on the inner side of the tuber ischii, sends one or frequently more twigs to the sphincter ani and margin of the anus (d: n. hæmorrhoidalis inferior); then it passes forward along the perinæum, in the interval between the erector penis and accelerator urinæ muscles, and, after furnishing filaments to them and the transversus perinæi, terminates in the dartos and the integuments of the scrotum.

The continuation of the pudic nerve ascends on the rami of the ischium and os pubis, where it gives some filaments to the obturator internus muscle. The nerve in the next place reaches the dorsum of the penis by passing between the corpus cavernosum and the pubic symphysis; after which it passes forwards beneath the skin as far as the glans, where its filaments cease to be discernible; it distributes filaments during its course to the integuments and the urethra.

In the female the pudic nerve presents nearly a like disposition, but the superficial perinæal nerve is larger than the deep-seated one just described, because it is distributed to the labium, whilst the other supplies the clitoris.

The small sciatic nerve (plate XXII. D; *nervus ischiadicus minor*, v. *gluteus inferior*,) arises from the posterior and lower part of the plexus, from which it inclines backwards and downwards to reach the lower border of the pyriformis muscle, beneath which it escapes from the pelvis. In this situation it will be found on the same plane with the great sciatic nerve, but on its inner side, both resting on the superior gemellus, and covered by the gluteus maximus. Here the nerve receives a short twig from the great sciatic, and may be said to divide into branches, which take different directions; one being directed outwards to the great gluteus, others inwards, and a third set downwards along the thigh. It is, however, more conformable with usage to consider the descending part as the proper continuation of the nerve, and the others as its offsets or branches. 1. The *inferior gluteal* branches

(plate XXII. f, f) may be so called to distinguish them from the superior gluteal nerve, (a branch given from the lumbo-sacral, or communicating nerve,) from which, at their exit from the pelvis, they are separated by the breadth of the pyriformis muscle. The greater number of these branches are short, as they have merely to turn outwards a little, in order to reach the pelvic surface of the gluteus maximus, to which they are distributed. One of them, however, may be observed to curve round the border of the pyriformis, and proceed obliquely forwards beneath the gluteus, extending as far as its anterior border. 2. A branch (g; *posterior and internal cutaneous*) inclines inwards beneath the tuber ischii, and divides into filaments, some of which are distributed to the gracilis, whilst others pierce the fascia, and become subcutaneous, ramifying in the integument that covers the upper and inner part of the thigh, as well as the perinæum and scrotum or labium. 3. From the posterior surface of the nerve proceeds the *middle cutaneous* branch (h); this passes along the anterior surface of the gluteus maximus to its lower border; then, perforating the fascia, it continues to descend, distributing filaments to the skin, as far as the popliteal space, where it terminates. More cutaneous twigs derived from this nerve will frequently be found piercing the fascia at different points, together with others to be presently noticed, which are given off from the great sciatic nerve.

The continuation of the small sciatic nerve, as it descends, inclines inwards, covered by the fascia, and rests on the flexor muscles, to which it distributes branches, in its course towards the inner side of the popliteal space, where it usually ceases.

Great sciatic nerve.—The great sciatic nerve (plate XXII. E: *nervus ischiadicus*, Scemm.; *grand fémoro-poplité*, Chauss.) is the largest nerve in the body. From its size and direction it may be considered as the continuation or prolongation of the plexus, it being impossible to determine where the one ceases or the other begins. The fasciculi which enter into its composition are derived from all the nerves which go to form the sacral plexus. Thus formed, the nerve emerges from the pelvis, beneath the lower border of the pyriformis muscle, (a portion sometimes passing through its fibres,) and lies in the interval between the trochanter major and tuber ischii, whence it proceeds almost vertically downwards to the popliteal space. In the upper part of this course it rests against the external rotator muscles, in the rest it is supported by the adductor magnus, and is covered for a short way by the gluteus maximus, and lower down by the flexor muscles of the leg; but in the ham it is placed in the interval between them, embedded in a quantity of adipose substance, and covered only by the fascia and integument. The branches of this nerve are necessarily very numerous:— 1. As it emerges from the pelvis it sends a branch to the obturator internus, and another to join the nerve last described. 2. From its posterior surface some filaments pass to the gluteus muscle, whose size and number depend on that of the inferior gluteal branches, derived from the small sciatic nerve, being few and small when the latter are numerous, and *vice versâ*; for here, as elsewhere, in the nervous as well as in the vascular system, a principle of compensation obtains, by which, when the supply from one source is considerable, that from another admits of being proportionally diminished. Farther down it gives filaments to the flexor muscles, as they lie over it. From some of these branches, or from the trunk itself, one or two others pass backwards, and directly pierce the fascia; after which they proceed down towards the external side of the ham, ramifying in the integuments. These may be termed the posterior and *external cutaneous* branches (plate XXII. k), to distinguish them from those that arise from the small sciatic nerve. 3. From its anterior surface branches proceed to supply the external rotators, (plate XXV. fig. 1, a, a) (a filament extending to the capsule of the hip-joint) and the adductor magnus, on which the nerve lies, and some pass outwards to the short head of the biceps muscle.

The sciatic nerve divides, generally about the middle of the thigh, into an external and internal branch,—the latter, in direction and size, being its proper continuation. This division sometimes takes place lower down than the point here indicated, and in many instances much higher,—occasionally even within the pelvis. The internal or larger division lies behind and to the outer side of the popliteal artery, whilst in the popliteal space; hence during that part of its extent it may be called the popliteal nerve. According to the arrangement usually adopted, the nerve is considered as dividing into two branches, viz. the posterior tibial and fibular. But were we to adhere to this division, we should have no popliteal nerve, and it would evidently be a misnomer to speak of the posterior tibial in the popliteal space, and describe its relations to the popliteal artery. When treating of the external division, we cannot avoid this otherwise than by a periphrasis.

The internal or larger division of the sciatic nerve (plate XXV. figs. 1 and 2, A; *popliteal, nervus popliteus*), passes directly downwards through the ham, covered by the fascia, and lying posterior and external to the popliteal vessels, from which it is separated by some adipose substance. After having

passed below the joint, it rests on the popliteus muscle covered by the gastrocnemius. In this situation it inclines inwards, and, crossing the artery, lies to its inner side. Like the artery, the nerve assumes the name of posterior tibial (*nervus tibialis posticus*), when it has passed below the popliteus muscle. In the leg it resumes its original position with regard to the blood-vessels, being again placed externally to them; here it lies on or rather behind the tibialis posticus and flexor communis muscles, covered by the deep fascia which separates it from the soleus. Gradually inclining to the inner side of the leg, the posterior tibial nerve, as it descends, passes through that arched interval which separates the inner ankle from the calcaneum, and, like the artery which it accompanies, divides into its two terminal branches, viz. the internal and external plantar.

In this course the nerve gives several branches to supply the muscles along which it passes. A branch of considerable size (plate XXV. fig. 1, b; *nervus cutaneus longus posterior*, vel *communicans tibiae*, Soemm.) runs directly downwards between the heads of the gastrocnemius, and then over the posterior surface of that muscle, gradually inclining outwards to reach the external border of the tendo Achillis. In this course the nerve accompanies the external saphenous vein; and about the middle of the calf of the leg, or sometimes lower down, it joins with a corresponding branch (c) sent from the fibular nerve. The nerve resulting from this union may be called *external saphenous* (d, d); with the vein so named it passes down behind the external ankle, so as to reach the dorsum of the foot, where it divides into two branches, one running on the fourth, the other on the fifth metatarsal bone, and distributing filaments as far as the corresponding digital phalanges. The branch here described lies beneath the fascia in its course down the leg, but at different intervals sends through it filaments which ramify in the integuments, some of them descending as far as the bend of the ankle. Several muscular branches proceed from the nerve to the heads of the gastrocnemius, the plantaris, popliteus, and soleus muscles; and in the lower part of its course it supplies the tibialis posticus, and the long flexors, its filaments diverging and uniting again so as in some places to form a mesh round the posterior tibial artery. Some filaments are also distributed on the ligaments at the ankle, and on the bursa and fascia near the insertion of the tendo Achillis.*

When arrived at the hollow of the calcaneum, and lying under cover of the abductor pollicis muscle, the posterior tibial nerve sends off a filament which ramifies in the integuments of the sole of the foot, previously to its division into the internal and external plantar branches.

Internal plantar nerve.—The internal plantar nerve (plate XXVI. fig. 1, A; fig. 2, B: *n. plantaris*

* Demonstration of the Nerves, by Mr. Swan.

PLATE XXVI.

In this plate the distribution of the plantar nerves to the sole of the foot is exhibited.

Fig. 1. The superficial layer of muscles, the plantar fascia having been removed.

No. 1. The abductor pollicis muscle. 2. The flexor brevis digitorum. 3. Part of the plantar fascia. 4, 4. The abductor minimi digiti muscle. 5. The border of the flexor brevis digiti minimi. 6, 6. The lumbricales muscles. 7. The tendon of the flexor longus pollicis.

A. The internal plantar nerve (*n. plantaris internus*).

a, a. Muscular branches. b, b. Digital branches. c, c. Muscular branches of the external plantar nerve. d. The digital branch of the external plantar nerve.

Fig. 2. A deep view of the sole of the foot; the superficial and part of the middle layer of muscles have been removed.

No. 1. The os calcis, with the attachment of the superficial layer of muscles. 2. The external head of the flexor accessorius muscle. 3. Its internal head. 4. The flexor accessorius cut across. 5. The common tendon of the flexor longus digitorum muscle. 6. The tendon of the flexor longus pollicis. 7, 7. The flexor brevis pollicis muscle. 8. The adductor pollicis. 9. The flexor minimi digiti muscle. 10. The transversus pedis muscle. 11. The third plantar interosseous muscle. 12. The second plantar interosseous. 13. The fourth dorsal interosseous muscle. 14, 14. The divided tendons of the flexor longus digitorum muscle. 15. The projection of the tendon of the peroneus longus muscle in its course across the foot.

A. The posterior tibial nerve (*n. tibialis posticus*). B. The internal plantar nerve (*n. plantaris internus*).

a. The first digital branch supplying the inner side of the great toe. b. The second digital branch supplying the adjoining sides of the great and second toes. c. The third digital branch supplying the adjoining sides of the second and third toes. d. The fourth digital nerve supplying the third and fourth toes. e. A muscular branch.

C. The external plantar nerve (*n. plantaris externus*).

f, f. Its muscular branches. g. Its deep branch. h. A digital branch supplying the adjoining sides of the fourth and fifth toes. i. The external digital branch distributed to the outer side of the little toe. k, k. Digital filaments to the dorsal surface of the toes.



Fig. 1.

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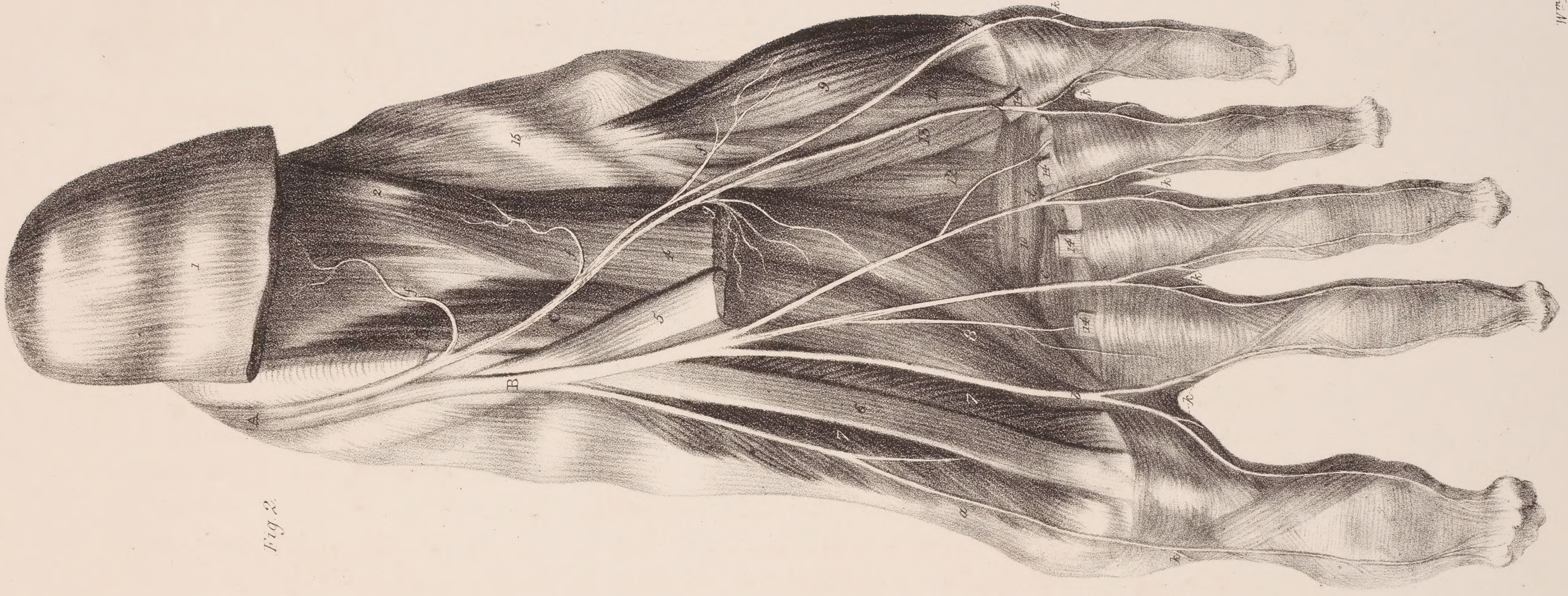
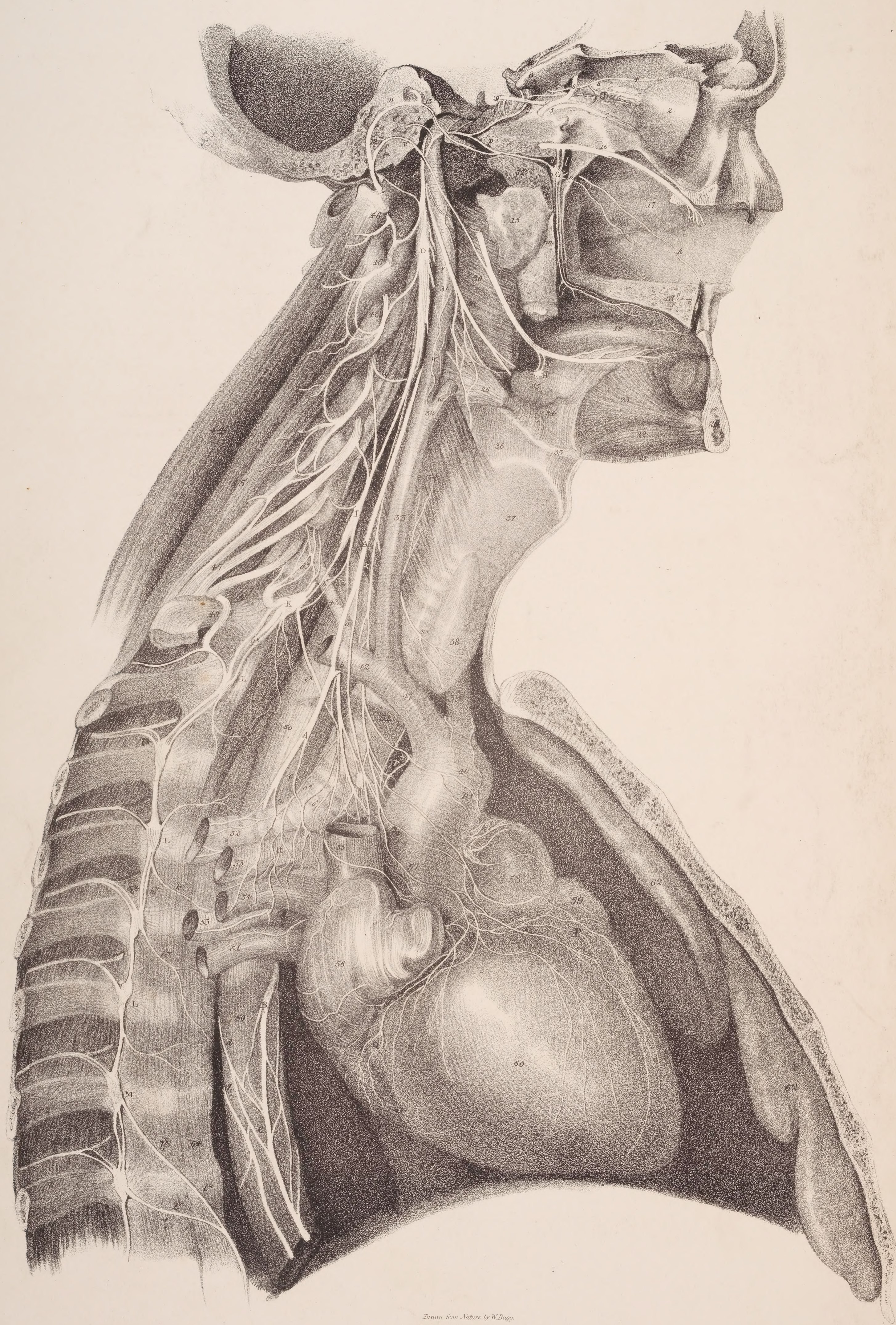


Fig. 2.

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W^m Fairland, Lith.

internus), the larger of the two, passes directly forwards beneath the tarsal bones, concealed by the abductor pollicis muscle, to which, as well as to the flexor accessorius and flexor brevis, it gives branches. It soon divides into, or gives off, four branches, intended to supply both sides of the great toe, and of the two next to it, as well as the inner side of the fourth. The first ramusculus (fig. 2, a) is smaller than any of the others; it proceeds forwards and inwards beneath the flexor brevis pollicis, to reach the inner side of the great toe, forming its first collateral branch: the second (b), as it passes forwards, corresponds with the interval between the first and second

PLATE XXVII.

Sympathetic nerve. The course and distribution of the sympathetic nerve in the upper half of the body. The distribution of the pneumo-gastric nerve on the right side is also shown.

No. 1. Section of the frontal bone through the frontal sinuses. 2. The posterior half of the globe of the eye. 3. The optic nerve. 4. The nasal branch of the ophthalmic nerve. 5. The trunk of the third nerve (n. motor oculi). 6. The ascending branch of the third nerve. 7. Its inferior branch. 8. The anterior clinoid process of the sphenoid bone. 9. Part of the sixth nerve (n. abducens). 10. The internal carotid artery lodged in the carotid canal. 11. A section of the petrous portion of the temporal bone. 12. The facial nerve (portio dura) descending through the aqueductus Fallopii to the stylo-mastoid foramen. 13. The angular swelling upon the facial nerve at the point where it is joined by the petrosal branch of the Vidian nerve. 14. A section through the root of the pterygoid process of the sphenoid bone, showing the Vidian canal. 15. Part of the external pterygoid plate of the sphenoid bone. 16. The superior maxillary nerve. 17. The septum narium. 18. Section of the hard palate. 19. The tongue. 20. Section through the symphysis of the lower jaw. 21. The cut edge of the mylo-hyoideus muscle. 22. The genio-hyoideus muscle. 23. The genio-hyo-glossus muscle. 24. The hyo-glossus muscle. 25. The submaxillary gland. 26. A part of the middle constrictor. 27. The pharyngeal plexus of nerves. 28. The glosso-pharyngeal nerve. 29. The gustatory branch of the fifth nerve. 30. The superior constrictor muscle. 31. The internal carotid artery. 32. The external carotid artery cut short. 33. The common carotid. 34. The origin of the inferior constrictor muscle, upon which is seen ramifying a branch of the recurrent nerve. 35. The os hyoides. 36. The thyro-hyoidean membrane. 37. The thyroid cartilage. 38. The thyroid gland. 39. The left carotid artery. 40. The arch of the aorta. 41. The arteria innominata. 42. The right subclavian artery. 43. The vertebral artery. 44. The levator anguli scapulæ muscle. 45. The scalenus posticus muscle. 46, 46. The second, third, and fourth cervical nerves. 47. The brachial plexus of nerves. 48. The ascending division of the first dorsal nerve, joining the brachial plexus. 49. The lower part of the longus colli muscle. 50, 50. The œsophagus. 51. The trachea. 52. The right bronchus. 53, 53. Branches of the right pulmonary artery. 54, 54. Right pulmonary veins. 55. The trunk of the superior vena cava cut off near the auricle. 56. The right auricle. 57. The ascending aorta. 58. The pulmonary artery. 59. The tip of the appendix of the left auricle. 60. The right ventricle. 61. The inferior cava. 62, 62. The two lobes of the left lung. 63. Section of the sternum. 64. The anterior common ligament of the vertebral column. 65, 65. Intercostal nerves.

A. The right pneumo-gastric nerve.

a. A cardiac branch from the pneumo-gastric nerve. b. The point at which the recurrent nerve is given off from the pneumo-gastric; the recurrent may be seen quitting the nerve to ascend behind the subclavian artery. c, c. Branches descending to form the anterior pulmonary plexus with the assistance of branches from the great cardiac plexus.

B. The left pneumo-gastric nerve. C. The œsophageal plexus.

d, d. Branches of the right pneumo-gastric nerve passing forwards to join the œsophageal plexus.

D. The superior cervical ganglion of the sympathetic nerve.

e. Its ascending branch, dividing to embrace the internal carotid artery in the carotid canal. f, f. The carotid plexus. g. Two branches from the carotid plexus to join the sixth nerve, 9. h. Sympathetic filaments ascending from the carotid plexus along the anterior cerebral artery to communicate with the ganglion of Ribes.

E. The ciliary or lenticular ganglion, giving off ciliary branches to the globe of the eye, 2. It sends a branch of communication to the nasal nerve, 4; and another to the inferior branch of the third nerve, 7.

i. A branch of communication to the carotid plexus.

F. The naso-palatine ganglion (Cloquet's ganglion).

j. Anterior palatine branches. k. The filament of communication with Meckel's ganglion.

G. The spheno-palatine ganglion (Meckel's).

l. Two ascending branches of communication with the superior maxillary nerve, 16. m, m. Descending branches; posterior palatine nerves. n, n. Anterior branches; spheno-palatine, or nasal nerves. o. Posterior branch; the Vidian nerve. p. Its carotid branch. q. Its petrous branch. r, r. The chorda tympani nerve. s. The chorda tympani, with another nervous filament, quitting the gustatory nerve to communicate with the submaxillary ganglion, H.

t. The nervus petrosus superficialis minor, a filament from the carotid plexus going to unite with the tympanic nerve on the inner wall of the tympanum. u, u. Branches of communication from the superior cervical ganglion to the upper cervical nerves. v, v. Internal branches to communicate with the pneumo-gastric nerve, and to assist in forming the pharyngeal plexus, 27. w, w. Nervi molles, accompanying the

metatarsal bones, where it gives filaments to the flexor brevis and the first lumbricalis, and, on reaching the fissure between the toes, divides into two offsets, which run along the contiguous borders of the first and second toes: the third (c) lies in the second metatarsal space, supplies the first plantar inter-osseous muscle, and, like the preceding branch, divides into two parts to supply the external border of the second toe, and the adjacent one of the third: the fourth ramusculus (d) follows a similar course and distribution with regard to the third metatarsal space, and the digital phalanges of the third and fourth toes; it also joins with, or receives a filament from, the superficial branch of the external plantar nerve.

External plantar nerve.—The external plantar nerve (plate XXVI. fig. 2; *n. plantaris externus*) proceeds forwards and outwards, lying between the flexor accessorius and flexor brevis digitorum. In this course it gives a branch which passes to the external border of the foot, and is distributed to the abductor minimi digiti; after which it divides into two branches, one being intended to complete the digital branches of the toes, the other to supply the deep-seated muscles in the sole of the foot. 1. The first of these, on reaching the extremity of the fifth metatarsal bone, sends along the outer border of the foot and of the little toe a collateral branch, similar to that which is given to the great toe by the internal plantar nerve. The continuation of the branch may be observed to correspond with the fourth metatarsal space, where it communicates by an oblique filament with the internal plantar nerve; after which it proceeds to the heads of the metatarsal bones, and divides into branches, which supply the external border of the fourth toe, and the adjacent one of the fifth. 2. The deep branch (g) sends outwards a filament to the flexor of the little toe, and then proceeds almost directly forwards into the sole of the foot, where it divides into branches, which supply the abductor pollicis, the inter-ossei, and transversus pedis muscles.

Fibular nerve.—The external division of the great sciatic nerve (plate XXV. fig. 1, B; fig. 2, C: *nervus peroneus, ramus peroneus nervi femoro-poplitei*) inclines outwards as it descends from the point of division towards the external condyle of the femur, to which it is guided by the border of the biceps muscle. It then proceeds obliquely forwards, lying in the interval between the external head of the gastrocnemius and the biceps, and reaches the posterior surface of the head of the fibula, where it may with propriety be named *fibular* or *peroneal*. The nerve continues to descend for a short way between the external surface of the bone and the peroneus longus muscle, where it is usually said to divide into two branches, one being named anterior tibial, the other the musculo-cutaneous. But as the latter, in size and direction, represents the continuation of the nerve, we shall so consider it, and treat the former as a branch, more especially as from its relations and course it is analogous to the inter-osseous branch in the fore-arm. The peroneal nerve (plate XXIV. fig. 2, B, B), as it passes downwards, lies between the peroneus longus and the extensor communis, and afterwards between the

- internal and external carotids. x, x. The superior cardiac nerve (*n. superficialis cordis*). y. The cord of communication between the superior cervical ganglion, D, and the middle cervical ganglion, I.
- I. The middle cervical ganglion (thyroid ganglion).
- z, z. Filaments of communication with the fifth, sixth, and seventh cervical nerves. a*, a*. The middle cardiac nerve (*n. cardiacus magnus*). b*. Cord of communication with the third cervical ganglion.
- K. The third cervical ganglion; brought into view by drawing the vertebral artery, 43, to one side.
- c*. A filament of communication with the eighth cervical nerve. d*. Filaments which ascend with the vertebral artery through the foramina in the transverse processes of the cervical vertebræ to accompany its branches.
- e*. The inferior cardiac nerve. f*. Two small filaments distributed to the posterior mediastinum. g*. Communicating filaments with the first dorsal ganglion.
- L, L. Dorsal ganglia of the sympathetic.
- h*, h*. Cords of communication between the ganglia. i*, i*. Filaments of communication with the intercostal nerves. k*, k*. Internal or aortic branches.
- M. The sixth dorsal ganglion.
- l*, l*. The two first branches that go to form the great splanchnic nerve.
- N. The great cardiac plexus.
- m*, m*. Filaments which descend in front of the ascending aorta to assist in forming the anterior cardiac plexus, O.
- P. The anterior or left coronary plexus. Q. Filaments which follow the course of the right coronary artery to the posterior aspect of the heart, where they assist in forming the posterior coronary plexus.
- n*. Filaments which descend upon the posterior aspect of the heart, and form the posterior cardiac plexus. o*, o*. Filaments which assist in forming the anterior pulmonary plexus, R. p*. Filaments which descend in front of the arch of the aorta to communicate with branches of the cardiac ganglion, q*.
- S. One extremity of the cardiac ganglion.
- r*. Branches from the cardiac nerves of the left side joining the great cardiac plexus. s*. A filament from the *nervus superficialis cordis* to the thyroid gland.

latter muscle and the peroneus brevis, giving branches to each. Towards the middle of the leg, it (fig. 1, B) escapes from under cover of the muscles, much diminished in size, descends for some way beneath the fascia, and divides into two branches—one being a little external to the other. The *external* branch (fig. 1, f), lying between the fascia covering the extensor tendons and the skin, passes over the bend of the ankle and dorsum of the foot, and divides into three ramusculi on reaching the latter situation. One of these is directed forwards, corresponding with the fourth metatarsal space, and ramifies in filaments on the dorsum of the little toe and outer border of the foot. In the latter situation its place is not unfrequently supplied by the external saphenous nerve. The next ramusculus passes along the interval between the fourth and third toes, supplying both; whilst the third, or most internal of them, is similarly disposed of on the phalanges of the third and second toes. The *internal* branch (fig. 1, e), is directed towards the base of the first metatarsal bone, on which, after having given some filaments to supply the inner border of the foot, it divides into two ramusculi, which ramify on the upper surface of the first and second toes.

Branches of the peroneal nerve.—The peroneal nerve sends, in the popliteal space, a branch which supplies the short head of the biceps muscle, and terminates on the ligaments of the outer side of the knee-joint. Its chief branches, taken in their order from above downwards, are as follows:

1. A considerable branch (plate XXV. fig. 1, c) is given off in the popliteal space, which descends between the external head of the gastrocnemius and the fascia, sending at intervals some branches which pierce the latter to supply the integuments. It finally divides into two or three branches, some of which ramify on the external side of the leg, whilst one joins with the superficial branch of the posterior tibial nerve, to form with it the communication alluded to in the description of the latter.

2. The anterior tibial, or inter-osseous nerve, (plate XXIV. fig. 2, C, C; *n. tibialis anticus*;) immediately after its origin below the head of the fibula, turns forwards and inwards between the surface of that bone and the peroneus longus and extensor communis muscles, giving branches to both. On reaching the inter-osseous ligament, it lies to the external side of the anterior tibial artery, but as it descends it inclines somewhat in front of that vessel, and so passes beneath the annular ligament of the ankle-joint to gain the dorsum of the foot. In this course the nerve gives off filaments to the muscles between which it lies, viz. the extensor proprius pollicis and tibialis anticus, and finally terminates in the situation just referred to by dividing into two ramusculi, of which one passes forwards and supplies the extensor digitorum brevis, and some of the inter-ossei, a few of its filaments uniting with the terminal branches of the peroneal nerve. The other division proceeds inwards over the first metatarsal bone, and ramifies on the first and second toes.

3. Several muscular branches are given by the peroneal nerve, in the upper part of the leg, to the peronei and extensor muscles; and, finally,

4. Some small cutaneous branches, which pass down towards the external ankle.

Sympathetic nerves.—The sympathetic nerves (*nervi intercostales*; *nerfs de la vie organique*, Bichât) form a system by themselves, characterised by many peculiarities which distinguish them from those nervous cords which are connected with the brain and the spinal cord. They extend from the cranium to the pelvis, lying along the vertebral column, and present a chain of ganglia connected by nervous filaments. In the infancy of anatomy the term “ganglion” was used to denote a swelling in the thecæ of tendons, and even at the present day it is not unfrequently employed in the same sense. It was subsequently applied to the knotted appearance presented by certain nerves; but of late years a considerable latitude has been given to its signification by Gall and Spurzheim, who include within its comprehension the several masses of cineritious substance enclosed within the spinal cord and the brain, and which, according to their theory, are considered “ganglia of increase” to the formative fibres of the cerebral hemispheres.

Nervous ganglia may be divided into two orders: 1. Those observable on the posterior roots of the cerebro-spinal nerves, including that of the fifth nerve, as well as the swelling on the nervus vagus and glosso-pharyngeal. To this group may be added those connected with the branches of the cerebro-spinal nerves, such as the ophthalmic, otic, sphenopalatine, sub-maxillary, and naso-palatine ganglia. 2. The ganglia of the sympathetic nerves.

To the latter we confine our attention in the present section. Previously to Bichât’s time, the sympathetic was considered as a nerve derived from the brain, and extended along the spinal column, presenting at stated intervals small knots or enlargements, but without interruption to its continuity. Bichât, however, supposed that the ganglia formed so many separate centres of nervous influence, and that each was connected with those near it by cords of communication. In this view of the matter, the sympathetic nerves may be compared to two chains, each made up of a number of separate links.

The question then arises, whether the nervous filaments pass uninterruptedly through the ganglia or not? Lobstein examined a portion of the cord after having subjected it to maceration for a long time, and found that the filaments which issue from the first cervical ganglion passed without any interruption through the second and third, down to the first thoracic ganglion; moreover, that they continue still through the second, third, and fourth of this series, lying towards the inner side of each, mixed somewhat with other filaments, though not in any way interrupted. But what, it will be asked, are the "other" filaments here alluded to as being extraneous to those which pass down through the ganglia? Are they the terminations of the branches derived from the cerebro-spinal nerves, according to the views of some anatomists, or the commencement of those which are given off from the ganglia to these nerves, according to others? This is altogether an open question—no answer can as yet be given to it. Each ganglion is invested by a thin investment of cellular tissue, which connects it with the surrounding structures, and forms a nidus for the vessels which supply its proper substance; but when this is removed, another lamella is found, forming an envelope for the filaments which enter and depart from the ganglion, as well as for that body itself. After long-continued maceration, we find the ganglion composed of delicate filaments, continuous at one extremity with the cord which enters it, and at the other with that which issues from it. The filaments seem as if unravelled, the interstices between them being filled with a greyish, semi-transparent, pulpy substance, which may be considered the peculiar matter of the ganglion. It has been supposed similar, if not identical with the cineritious substance of the brain; but that remains to be determined by future inquirers.

At one time the nervous cord now under consideration was said to arise from the sixth cerebral nerve, by filaments which pass down from it as it crosses the cavernous sinus; so that it would appear to be derived from the brain through the medium of the nerve just named. Some assign it a great number of roots derived from the spinal nerves, inasmuch as each of them is connected with it by filaments which appear to issue from them as they pass out of the intervertebral foramina. Were this

PLATE XXVIII.

The sympathetic nerve of the right side in the lower half of the body.

No. 1. The right ventricle of the heart. 2. The right auricle. 3. The left auricle.

a, a. Some filaments of the anterior coronary plexus. b, b. Filaments of the right coronary plexus.

A, A. The dorsal portion of the sympathetic nerve. B. The sixth dorsal ganglion. C. The twelfth dorsal ganglion.

c, c. Communicating branches to the intercostal nerves, 4, 4.

D. The greater splanchnic nerve (nervus splanchnicus major). E. The right semilunar ganglion.

d. A large branch of communication between the right pneumo-gastric nerve and the semilunar ganglion.

5. The œsophagus, with part of the œsophageal plexus. 6. The thoracic aorta. 7. The anterior common ligament.

e. A small aortic branch from the sympathetic, communicating with other aortic filaments derived from the dorsal ganglia of the left side.

8. Filaments accompanying the coronary artery of the stomach, and forming the coronary plexus. 9. The splenic artery, with a part of the splenic plexus. 10. The hepatic artery, with a part of the hepatic plexus. 11. The superior mesenteric artery, upon which are seen ramifying some filaments of the mesenteric plexus.

F. The lesser splanchnic nerve (nervus splanchnicus minor). G. The renal plexus ramifying upon the renal vessels.

f. A branch from the lesser splanchnic nerve to communicate with the semilunar ganglion. g, g. Filaments from the semilunar ganglion to the renal plexus. h. Filaments from the renal plexus to the renal capsule.

12. The renal capsule. 13. The right kidney. 14. The ureter. 15. The inferior vena cava. 16. The left renal vein. 17. The right spermatic vein. 18. The common iliac vein. 19. The abdominal aorta. 20. The inferior mesenteric artery. 21. The right common iliac artery. 22. The left common iliac artery.

H, H. The lumbar portion of the sympathetic.

i, i. Filaments of communication with the anterior branches of the lumbar nerves, 23, 23.

24, 24. The lumbar plexus. 25. The lumbo-sacral nerve.

k, k. Filaments of communication with the aortic plexus. l, l. The aortic plexus. m. The inferior mesenteric plexus.

I. The hypogastric plexus. K. The right lateral portion of the hypogastric plexus, receiving branches from the sacral nerves and sacral ganglia. L, L. The sacral portion of the sympathetic nerve. M. The terminal or azygos ganglion (ganglion impar). N, N. Sacral nerves.

n, n. Branches from the sacral nerves communicating with the lateral portion of the hypogastric plexus.

26. The articulating surface of the sacrum. 27. The rectum. 28. The prostate gland. 29. The vesicula seminalis. 30. The urinary bladder. 31. The symphysis pubis. 32. The iliacus internus muscle of the left side.

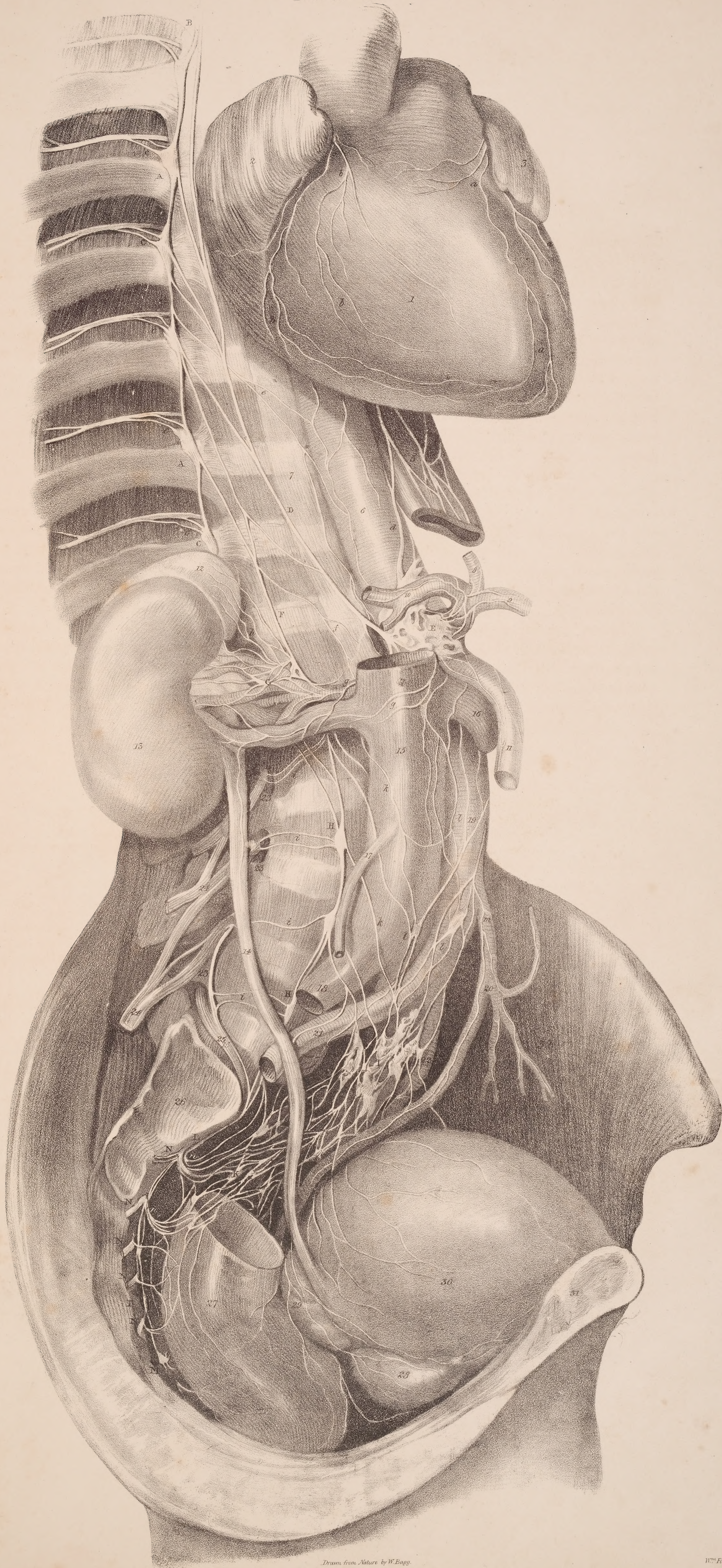


Fig 1.

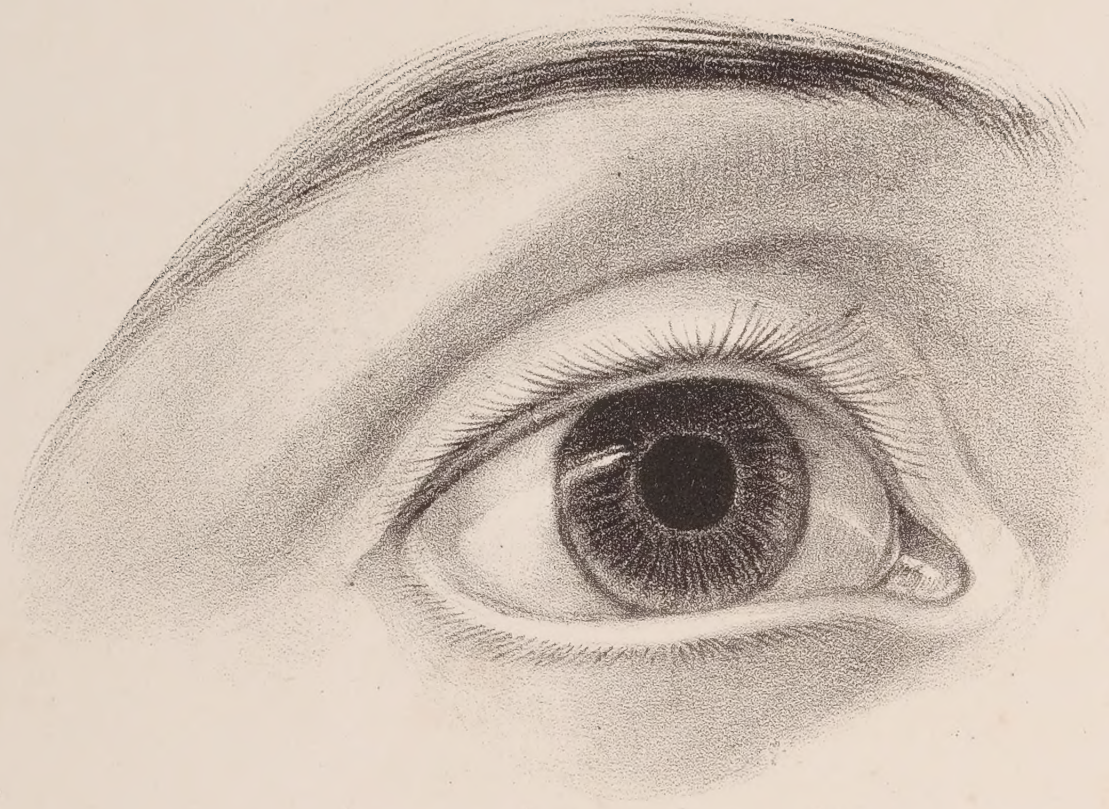


Plate 29.

Fig 2.

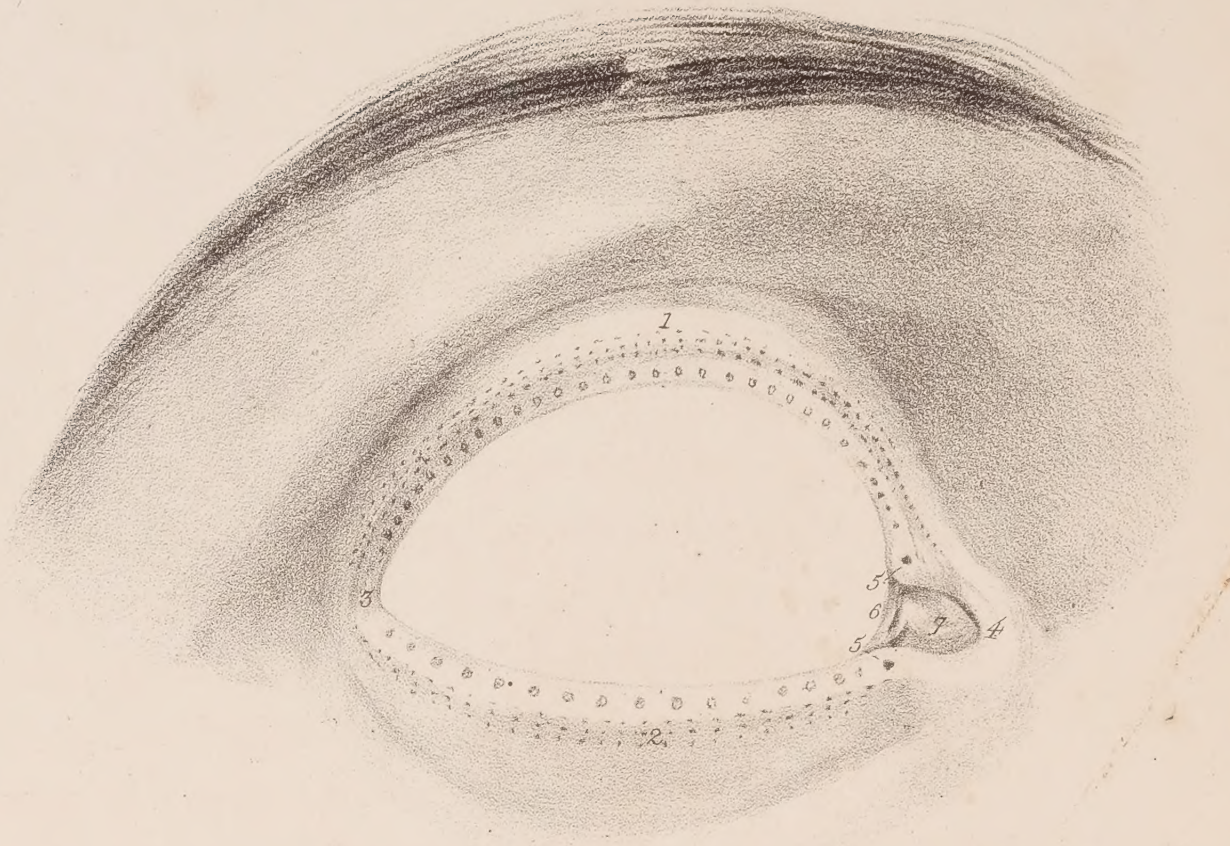


Fig. 5.



Fig. 6.

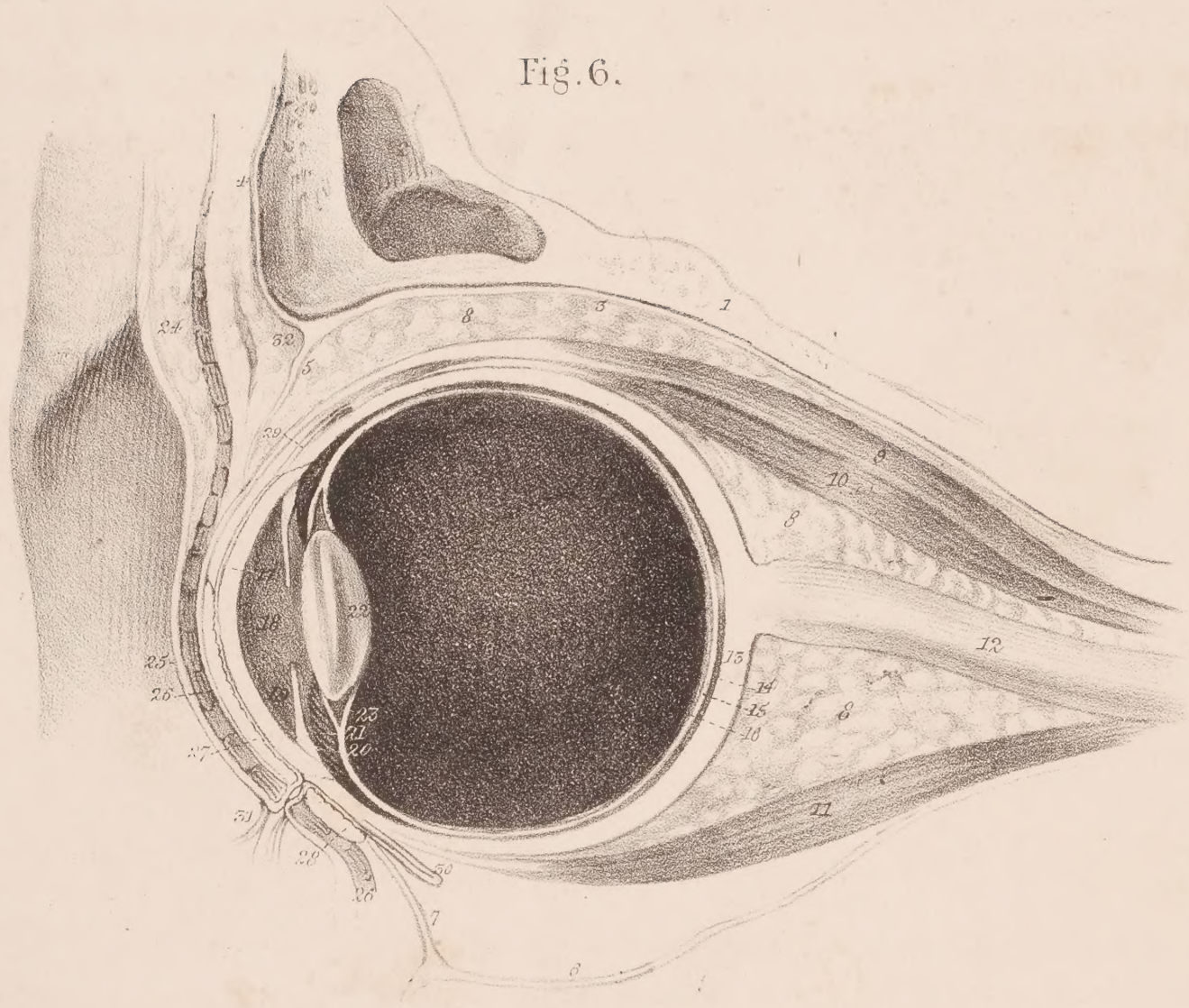


Fig. 7.



Fig. 3.

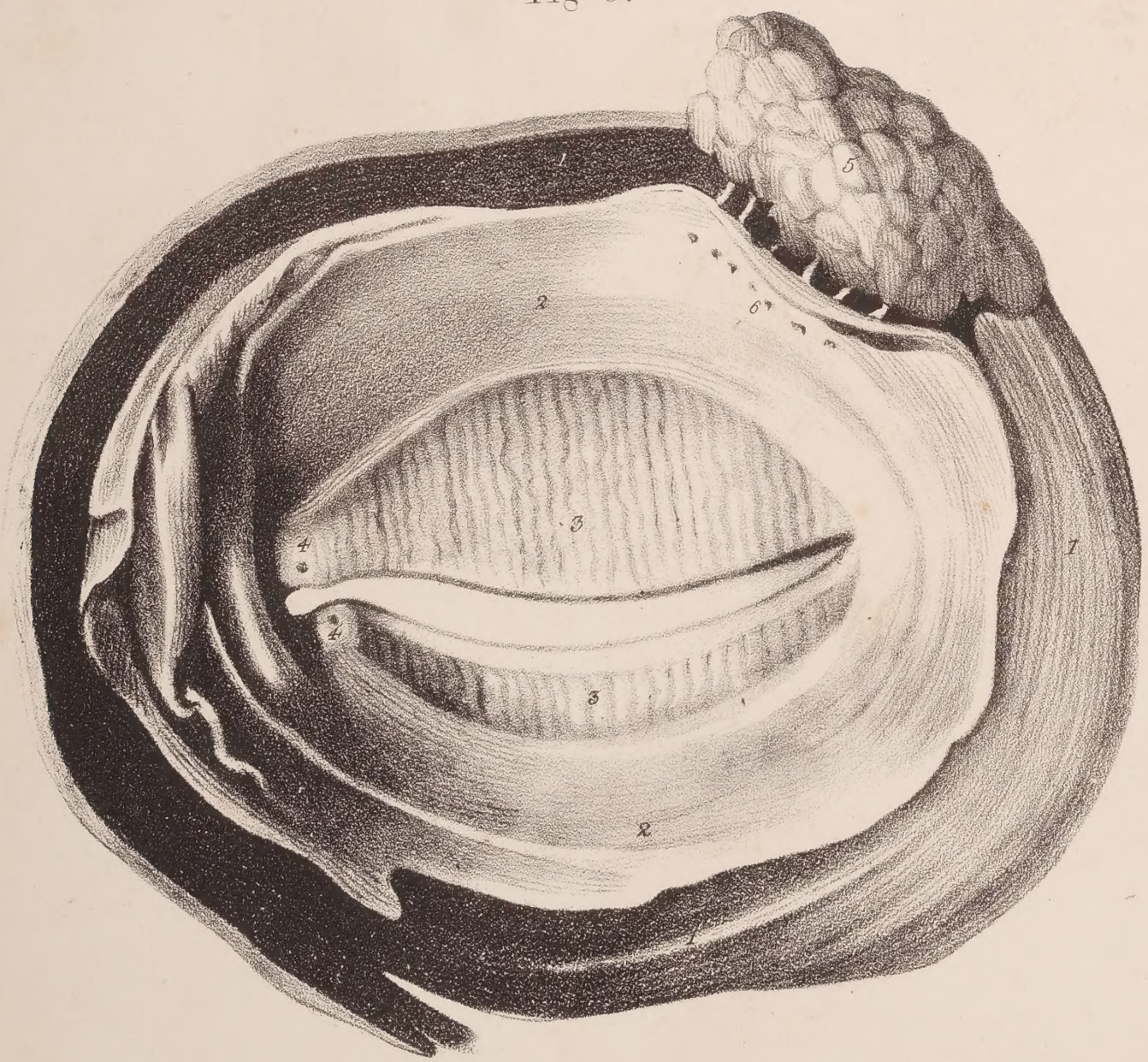


Fig 4.



opinion tenable, the sympathetic nerve may be likened to a creeping plant, which as it elongates acquires new joints, each of which takes root so as to form a new centre of increase. But we cannot now view the matter in this light. It is not at all correct to say, that this nervous cord arises, or starts from, or begins at, the sixth nerve; and nothing but the imperfection of language can justify the expressions, "the nerve arises from and proceeds to," or "the nerve gives off a branch which goes to form a plexus or a ganglion;" for every nerve, vessel, ganglion, or muscle—every organized part or structure, whether a compound organ or a simple filament—is secreted and deposited in its proper place by its own vessels, and no such elongation of it does or can take place as is implied by the phrase, "it arises above, proceeds down, and terminates in such a manner." Now, as to the sympathetic nerve, so far from being in any way derived from the brain or the spinal cord, it is produced independently of either, and exists notwithstanding the absence of both. It is found perfectly formed in acephalous infants, therefore does not arise mediately or immediately from the brain; neither can it be said to receive roots from the spinal cord, for it is known to exist as early in the foetal state as the cord itself, and to be fully developed even though the latter be altogether wanting.

It appears that whilst the organs of vegetative life are being formed, the sympathetic nerves are produced concurrently with them, and that as the growth of these parts proceeds from the circumference to the centre, and of the whole body from its lateral parts to the median line, the sympathetic nerves also conform to this general law. The two cords which represent them are placed one at each

PLATE XXIX.

The anatomy of the appendages of the eye is shown in this plate.

Fig. 1. The eye-brow (supercilium); eye-lids (palpebræ); eye-lashes (cilia); plica semilunaris, and caruncula lachrymalis, are seen in this figure, together with the front surface of the eye-ball. The dark circular hole in the centre of the transparent part of the eye is the pupil, and the surrounding disk the iris.

Fig. 2. The eye-lashes have been removed, to show that they are implanted in a triple row.

No. 1. The three rows of small openings for the passage of the cilia in the upper lid. 2. The three rows of openings for the cilia in the lower lid. The larger openings, placed in a single row near the edge of the lids, are the terminations of the Meibomian follicles. 3. The outer angle (canthus) of the eye. 4. The inner canthus. 5, 5. The lachrymal tubercles, upon which are seen the openings (puncta lachrymalia) of the lachrymal ducts. 6. The plica semilunaris, a small fold of the conjunctiva. 7. The caruncula lachrymalis.

Fig. 3. An internal view of the eye-lids.—(From Sæmmering.)

Nos. 1, 1. The inner surface of the orbicularis palpebrarum muscle. 2, 2. The conjunctiva lining the inner surface of the eye-lids. 3, 3. Slight elevations upon the inner surface of the lids, formed by the projection of the Meibomian follicles. The semilunar outline of the two lids results from the form of the tarsal cartilages. 4, 4. The lachrymal tubercles, upon which are seen the puncta lachrymalia, the openings of the lachrymal ducts. 5. The lachrymal gland seen upon its under surface. 6. The openings of the seven excretory ducts of the lachrymal gland.

Fig. 4. The lachrymal ducts and lachrymal sac and nasal duct.

Nos. 1, 1. The puncta lachrymalia. 2, 2. The lachrymal ducts. 3. The lachrymal sac. 4. The nasal duct. 5. The caruncula lachrymalis. 6. The plica semilunaris. 7. The lachrymal gland, seen from the anterior surface.

Fig. 5. The lachrymal gland, seen upon its upper surface.

Fig. 6. A vertical section of the orbit and globe of the eye, for the purpose of showing the anatomical composition of the eye-lids, and their relation to the surface of the eye.

No. 1. The cut edge of the orbital plate of the frontal bone. 2. A part of the left frontal sinus. 3. The periosteum of the roof of the orbit, which is continuous with the pericranium, 4; and with the broad ligament, 5, of the upper eye-lid. 6. The periosteum of the inferior wall of the orbit. 7. The broad ligament of the lower lid. 8, 8. The fat enclosed in loose cellular tissue which fills up all the vacant spaces in the orbit. 9. The levator palpebræ muscle inserted by its tendon into the convex border of the tarsal cartilage of the upper eye-lid. 10. The superior rectus muscle. 11. The inferior rectus muscle. 12. The optic nerve. 13. The sclerotic coat of the eye-ball, thicker posteriorly than in front. 14. The dark line, is the choroid coat. 15. The white line within the choroid, is the retina. 16. The thinner white edge within the retina, is the hyaloid membrane. 17. The cornea. 18. The anterior chamber. 19. The divided edge of the iris, attached by its circumference to the ciliary ligament, 20. 21. The divided edge of the ciliary processes. 22. The lens, surrounded by the canal of Petit, 23. 24. The integument of the forehead. 25. The thin integument of the upper eye-lid. 26, 26. The orbicularis palpebrarum muscle. 27. The tarsal cartilage of the upper lid. 28. The tarsal cartilage of the lower lid. 29. The fold of conjunctiva of the upper lid. 30. The fold of conjunctiva of the lower lid. 31. The eye-lashes. 32. The corrugator supercilii muscle cut across.

Fig. 7. The inner surface of the two tarsal cartilages, showing the Meibomian follicles partially embedded in their structure. The upper lid is broad and semilunar, the lower narrow. The ducts are seen opening along the margins of the cartilages. This figure is drawn from nature.

side along the sides of the spine; branches of communication connect them, on the one hand, with the ganglia and plexus along the middle line in front of the spine, and on the other with the nerves of animal life. Thus we see that the sympathetic nerves, though forming a system in themselves, present two parts—1. one consisting of the ganglia and plexus in immediate connexion with the different organs, and placed in front of the spine, hence named *prævertebral*, viz. the semilunar ganglia in the abdomen, (and the plexus in connexion with it, viz. the mesenteric, hepatic, stomachic, aortic, &c.) the cardiac ganglion and pulmonary plexus in the thorax, and the pharyngeal plexus in the neck; 2. and another, represented by the two knotted cords extended along the sides of the spine connected with the preceding by numerous branches, and also with the nerves of animal life, being, as it were, interposed between the vegetative and the animal sphere, and most likely constituting the bond of sympathy between both, as well as between the different individual parts of the former.

When we examine these lateral cords, we find that they present each twelve knots or ganglia in the thorax, five in the abdomen, and four along the sacrum, with a single or azygos one at the extremity. So far they appear to correspond with the pieces of the spine. Seeing this in three regions of the body, we should be disposed to expect a similar conformity in the cervical and cranial parts. We should perhaps be prepared to find the chain extended from the thorax along the cervical vertebræ, not in front, but at the sides of the bodies of the vertebræ, and therefore concealed from view by being enclosed within the foramina of the transverse processes. And in the cranial region we should feel disposed to keep up the analogy, by considering what is called the first or great cervical ganglion, as that which corresponds with the first cranial piece (the occipital bone); the spheno-palatine ganglion as being in relation with the second cranial piece; the ophthalmic with the third; and the naso-palatine as the counterpart at the anterior extremity of the osseous structure of the system, with the azygos already stated to exist at the extremity of the coccyx. Such a correspondence as this, however, cannot be fairly established. In the cranial region the approach to it is as near as could be expected, considering the difference of form and development between the cranial and dorsal pieces; but in the neck we find but three ganglia, which are thrown forwards and out of line, so as to rank with the *prævertebral* rather than with the lateral part of the sympathetic system. And when we remove the anterior roots of the transverse process in the neck, (which are but appendages to them, being in fact rudimentary ribs,) we find upon the vertebral artery a plexus, but not a chain of ganglia. De Blainville says,* that in the elephant it has been found; but he does not give a reference to the person on whose authority the statement rests. Perhaps it may not be out of place to observe, that, as the organs of assimilation, secretion, and circulation, are placed in subordination to the sympathetic nerves, (or nerves of vegetative life, as they are frequently called,) the thoracic and abdominal parts of the sympathetic system are highly developed; and that the cervical is much less so, having fewer ganglia and smaller plexuses, whilst the nerves of animal life are numerous and large, inasmuch as the upper part of the alimentary canal and the larynx are strictly voluntary organs, and through the medium of their proper nerves are subjected to the immediate control of the will. Again, the small and large intestines are supplied exclusively by the sympathetic nerves, as far as the rectum; there the nerves of animal life begin to be received, and towards its lower extremity predominate over the others, giving it, through the agency of its sphincters and levator, a strictly voluntary power. Concurrently with this change, as if by a principle of compensation, the sacral ganglia diminish in size, and become uncertain in their number.

The consistence of the sympathetic nerves is very variable, some being rather firm and dense, others so tender as to be easily torn, and so soft as to have received the name of "*nervi molles*." Their colour, and that of their ganglia, varies. They are not of that clear whiteness which the cerebro-spinal nerves present; their tinge is like that of mother-of-pearl. The thoracic ganglia are of the same aspect, but the semilunar and the first cervical are reddish, particularly the former, which in many cases looks almost fleshy.

In order to facilitate the description of the sympathetic nerves, it becomes necessary to consider them as divisible into superior, middle, and inferior portions, corresponding with the cervical and cranial regions, the thoracic, and the abdominal. As they are symmetrical, the description of one will suffice for both. Each nerve consists, in most instances, of three cervical ganglia, twelve dorsal, five lumbar, and four or five sacral, with their cords of connexion. To these should be added some small ganglia in the cranium; viz. the ophthalmic or lenticular in the orbit, the spheno-palatine or the ganglion of Meckel, the submaxillary, the otic or auricular as described by Arnold, the cavernous, the

* Cours d'Anatomie et de Physiologie Comparée.

naso-palatine as indicated by Cloquet, and one described by Ribes as being placed on the branch of communication between the anterior cerebral arteries. We shall commence with the superior cervical ganglion.

Superior cervical ganglion and its branches.—The superior, or great cervical ganglion (plate XXVII. D), is elongated and fusiform, so as to extend from two or three lines beneath the base of the skull, to the transverse process of the third or fourth cervical vertebra. Its length varies considerably in different cases, being from an inch and a half to two inches, or even more. Lobstein found it in one case to measure thirty lines; its thickness is about two or three lines. It lies on the rectus anticus muscle, concealed by the jugular vein and carotid artery. Branches proceed from it in every possible direction, which may be arranged into sets as follow—ascending, descending, external, internal, and anterior.

The *ascending* branches (e) are two in number; they enter the foramen caroticum, and form round the artery a plexus (f, f; *plexus caroticus*, v. *cavernosus*). Upon one of the filaments forming this plexus or interlacement round the artery, a gangliform enlargement sometimes is seen at the first curvature of the vessel, and which has been termed the carotid ganglion (ganglion caroticum). From the plexus filaments are traced upwards connecting it with the sixth, fifth, and third nerves, and the ophthalmic ganglion, as follows:—two filaments (g) pass upwards to communicate with the sixth nerve in the cavernous sinus;—one or two may also be traced along the carotid artery as far as the minute ganglion placed on the arteria communicans, and from this point filaments extend upon the coats of the artery throughout its ramifications; another terminates in the pituitary gland and infundibulum; one joins the third pair before it passes into the orbit, and one or two extend to the ophthalmic branch of the fifth. A filament also ascends to the nasal branch of the ophthalmic nerve, and is prolonged to the ophthalmic ganglion; and another communicates with the descending branch of the Vidian nerve. We may, however, consider these last-named branches as being derived, the one from the ophthalmic ganglion, and escorted for a while by the fifth nerve, in order to be ultimately prolonged to the carotid plexus, so as to connect the ganglion here named with the rest of the system; and the other (p), viz. the inferior branch of the Vidian, as being continued to the same point, in order to associate Meckel's ganglion, and thereby the naso-palatine ganglion, with the general gangliac system. Finally, from the plexus a filament (t) is derived, which is conducted by a minute aperture from the carotid canal into the tympanum to join the tympanic branch of the glosso-pharyngeal nerve.

The *external* branches (u, u) derived from the first cervical ganglion are short, and pass outwards to the superior cervical nerves, at the points at which they appear in front of the neck.

The *internal* set (v, v) incline obliquely inwards to the parts placed along the middle line, particularly to the pharynx, where they contribute to the formation of the pharyngeal plexus.

The *anterior* branches are very numerous; some of them communicate by anastomosis with the vagus, glosso-pharyngeal, lingual, and facial nerves. Others pass forwards on the external carotid artery, and accompany its different ramifications. These, from their appearance, are called *nervi molles* (w, w); they may be arranged in five sets of filaments, corresponding with the arteries which they accompany, viz. the superior thyroid, the laryngeal, the lingual, the labial, and ascending pharyngeal.

The *descending* branches are divisible into two sets. The first are two or three which unite to form the superficialis cordis nerve (x, x); the other (y) is the cord by which the superior cervical ganglion is connected with the middle or inferior one, forming the continuation of the sympathetic nerve. It is in general a long and thin branch, but in some instances its place is supplied by two filaments running parallel. It descends behind the sheath of the vessels, resting on the rectus anticus and longus colli, and opposite the fifth cervical vertebra it joins the middle ganglion: but as this sometimes does not exist, particularly at the right side, the nerve continues its course to the third ganglion. This branch usually gives filaments which communicate with the second and third cervical nerves, with the par vagum and the cardiac nerves.

Middle cervical ganglion.—The middle cervical ganglion (plate XXVII. I), when it exists (which is not always the case), is small, and very variable in its shape. It will be found on a level with the transverse process of the fifth or sixth cervical vertebra, where it is concealed by the sheath of the great vessels. It is so constantly in relation to the inferior thyroid artery, that Lobstein names it “ganglion thyroideum.” It receives the branch of communication (y) sent down to it from the superior cervical ganglion, and gives one (b*) which connects it with the inferior. From its external side, branches (z, z) pass to the third, fourth, and fifth cervical nerves; some proceed inwards upon the

thyroid artery, others to communicate with the recurrent nerve. Finally, from its fore part issues the middle cardiac nerve (a*, a*), and some filaments which join the plexus on the subclavian artery.

Inferior cervical ganglion.—The inferior cervical ganglion (plate XXVII. K) is also variable in its form, being usually single, but sometimes double. It lies in the angle between the transverse process of the last cervical vertebra and the neck of the first rib, close by the vertebral artery, which almost conceals it from view. It receives the communicating branch (b*) from the middle ganglion, and sends down four or five (g*), which pass, some in front, some behind the subclavian artery, and end in the first thoracic ganglion; in some instances it is placed in such close contact with the latter, that they become united inseparably, as if they were but one nervous mass. Some branches (c*) pass outwards, which soon join the spinal nerves that form the axillary plexus, particularly the seventh, eighth, and first dorsal; whilst others pass inwards, to contribute to the formation of the pulmonary plexus. An ascending branch enters the canal formed by the chain of foramina in the transverse processes of the cervical vertebræ, and forms a *plexus* (d*, *vertebral*) upon the vertebral artery. The filaments of this interlacement can be traced upon the vessel up to the base of the skull, at each step of its ascent maintaining communications with the spinal nerves, from the fifth up to the first. Finally, the inferior cardiac nerve (e*) may be considered as the anterior branch of the ganglion.

Before we proceed to describe the thoracic portion of the nerve, it may be well to conclude our

PLATE XXX.

The anatomy of the globe of the eye.

Fig. 1. The external tunic of the eye.

No. 1. The sclerotic coat. 2, 2. Small openings in the posterior aspect of the sclerotic for the passage of ciliary arteries and nerves. 3. The optic nerve. 4. The constriction of the sheath of the optic nerve at its junction with the sclerotic coat. 5. The insertion of the superior rectus muscle. 6. The insertion of the external rectus muscle. 7. The insertion of the inferior rectus. 8. The tunica albuginea, formed by the expansion of the tendons of the four recti muscles. 9. The cornea, through which is seen the iris and a part of the pupil.

Fig. 2. The second tunic of the eye-ball, seen from its nasal side.—(From Sæmmering.)

No. 1. The posterior part of the sclerotic coat; the rest having been removed to bring the choroid coat into view. 2, 2. The choroid coat, upon which are seen the whirls of the *venæ vorticosæ*. 3. The long internal ciliary artery. 4. The internal ciliary nerve. 5. Ciliary veins returning from the iris between the long ciliary nerve and artery. 6, 6. Ciliary nerves. 7. The ciliary ligament. 8. The iris. 9. The opening of the pupil.

Fig. 3. The second tunic of the eye-ball, seen from its inferior side. If this figure be compared with the preceding, it will be observed that, in consequence of the entrance of the optic nerve into the eye-ball on the nasal side of the globe of the eye, the inferior side is longer than the internal, and therefore the edge of the iris only is seen.—(From Sæmmering.)

No. 1. The posterior part of the sclerotic coat. 2. The optic nerve. 3, 3. The choroid coat. 4. A ciliary nerve formed by the union of two distinct filaments. 5, 5. Ciliary nerves. 6. The whirls of the *venæ vorticosæ*, called by Sæmmering the “inferior venarum vortex.” 7. The ciliary ligament. 8. The edge of the iris.

Fig. 4. The third tunic of the eye-ball, seen from the outer side of the globe of the eye.

No. 1. The retina. 2. The foramen of Sæmmering surrounded by a yellow halo—the *limbus luteus*. 3. The optic nerve stripped of its neurilema. 4, 4. The scalloped anterior margin of the retina. 5. The zonula ciliaris, connected posteriorly with the scalloped border of the retina, and attached anteriorly to the anterior surface of the lens. 6, 6. The anterior fluted boundary of the canal of Petit. 7. The lens.

Fig. 5. A horizontal section of the globe of the eye.

No. 1. The sclerotic coat, thicker posteriorly than in front. 2. The sclerotic coat, continuous with the neurilema of the optic nerve. 3. The bevelled anterior margin of the sclerotic, receiving the edge of the cornea. 4. The cornea. 5. The external or venous layer of the choroid coat, which is continuous anteriorly with the ciliary ligament, 6. 7. The internal or arterial layer of the choroid coat, continuous anteriorly with, 8, the ciliary processes. 9. The retina. 10. The zonula ciliaris, continued forwards from the anterior border of the retina to the front surface of the lens. 11. The hyaloid membrane. 12. That portion of the hyaloid membrane which is continued behind the lens. 13. The anterior chamber of the eye. 14. Its lining membrane, which secretes the aqueous humour. 15. The iris, composed of two layers. Three layers are seen in the figure: the most anterior is the membrane of the aqueous humour; the second, thicker than the first, is the fibrous layer; and the third, the dark layer, represents the uvea. 16. The opening of the pupil. 17. The posterior chamber. 18. The lens, showing its concentric structure. 19. The capsule of the lens. 20. The canal of Petit, bounded in front by the zonula ciliaris, behind by the hyaloid membrane, and internally by the edge of the lens. 21. The vitreous humour, contained in a delicate cellular tissue formed by the hyaloid membrane. 22. The canal of hyaloid membrane which traverses the vitreous humour and contains the artery of the lens. 23. The nervous substance of the optic nerve piercing the choroid membrane, and terminating in the retina. 24. The *arteria centralis retinæ*, passing through the centre of the optic nerve.

Plate 30

Fig. 1.

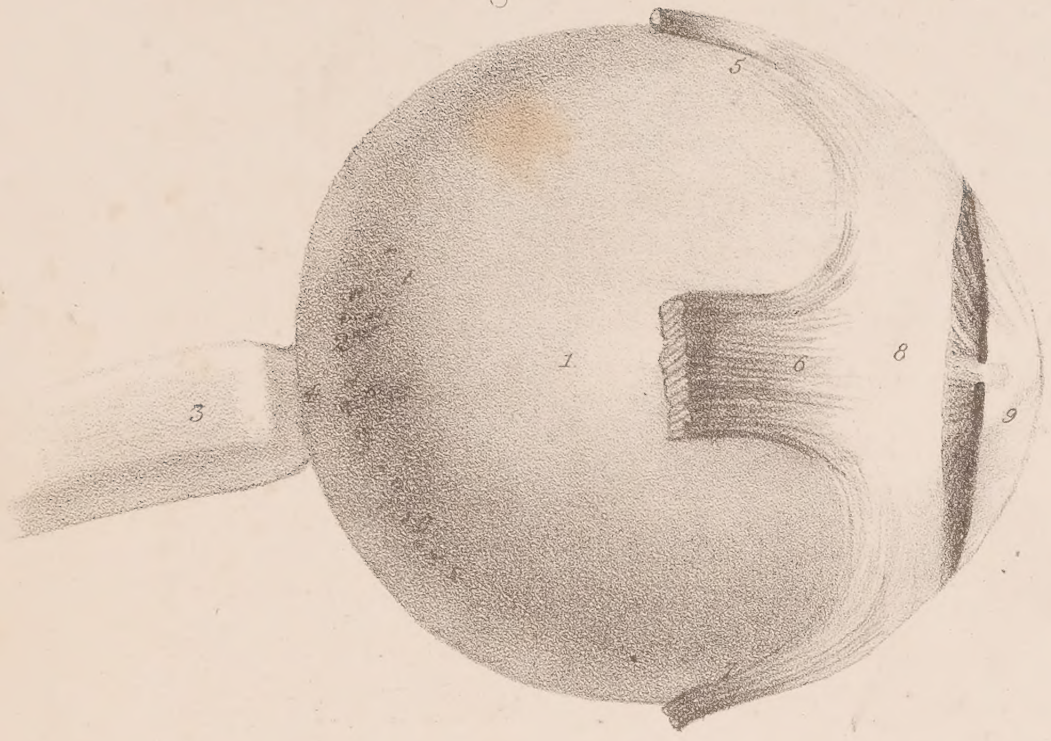


Fig. 2.



Fig. 5.

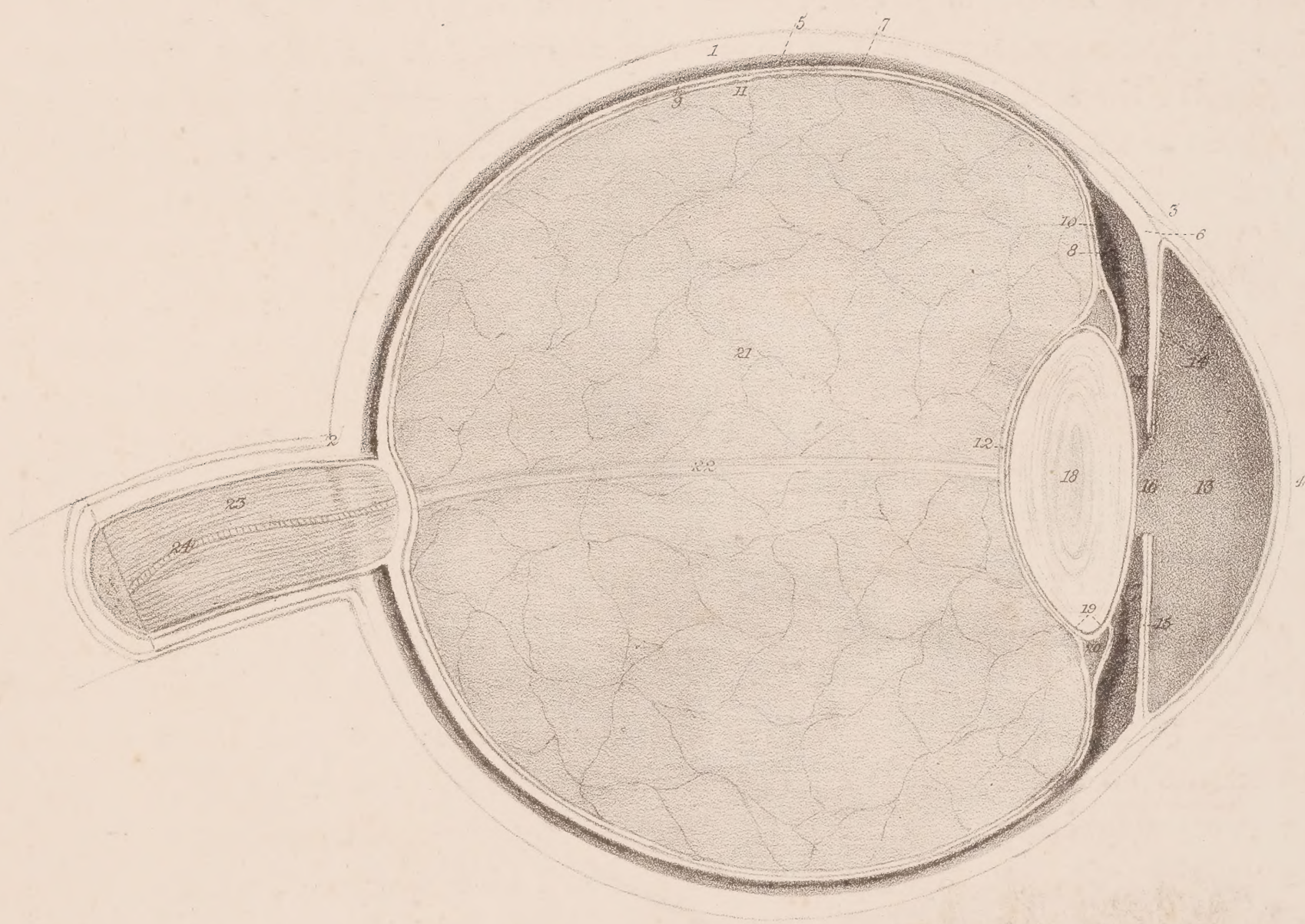


Fig. 3.

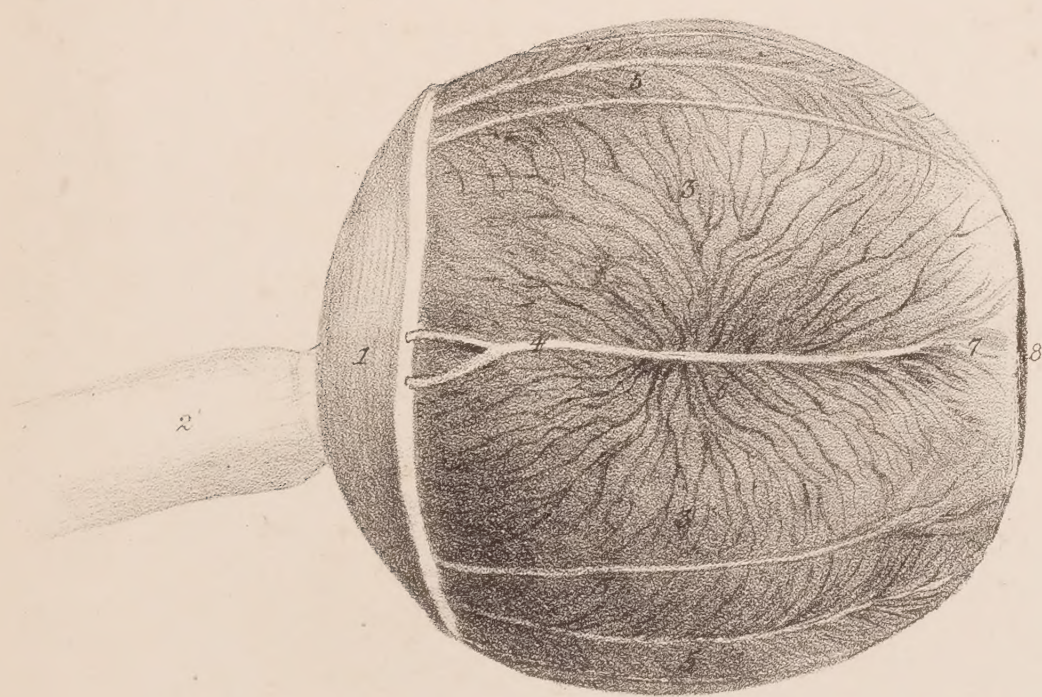


Fig. 4.

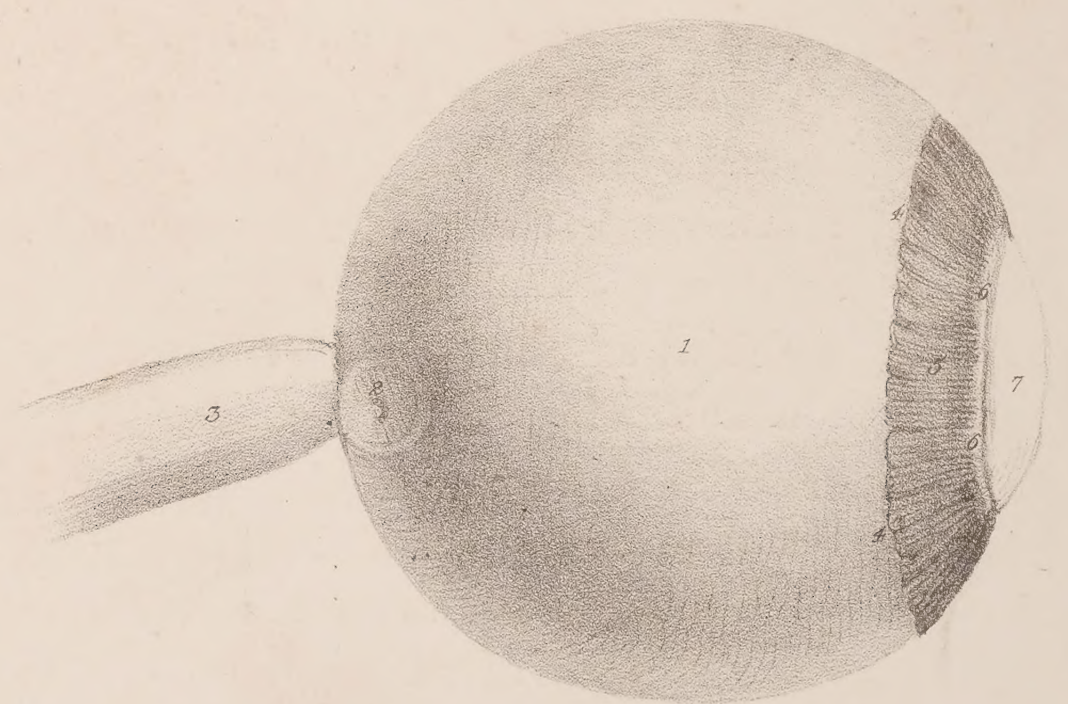


Plate 31.

Fig 1.

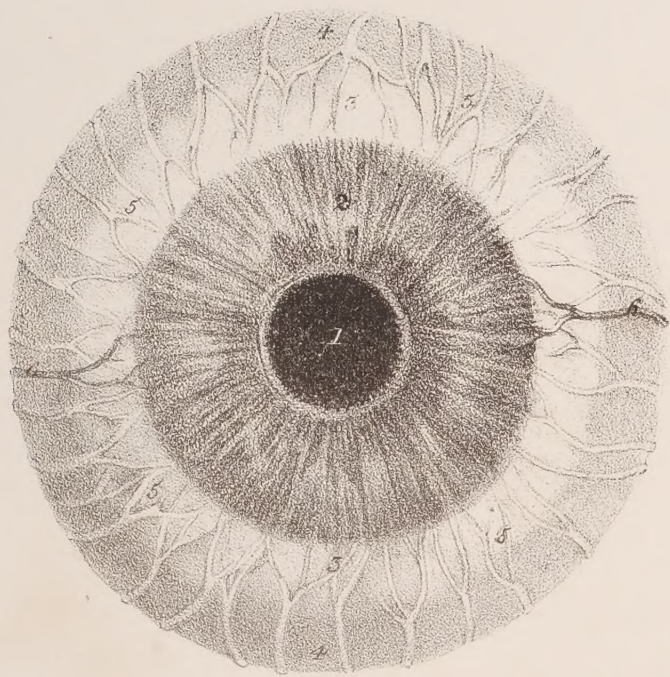


Fig 2.

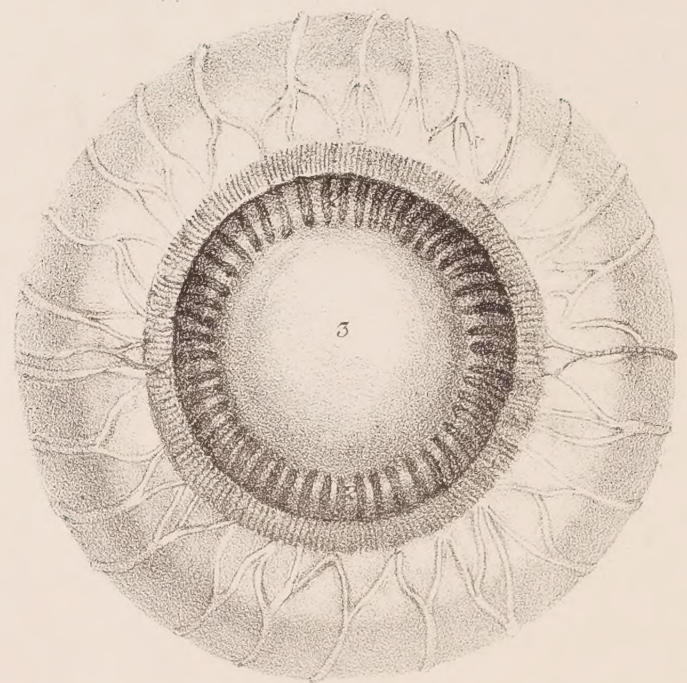


Fig 6.

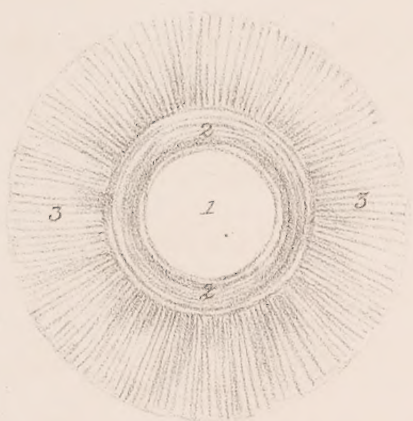


Fig 7.

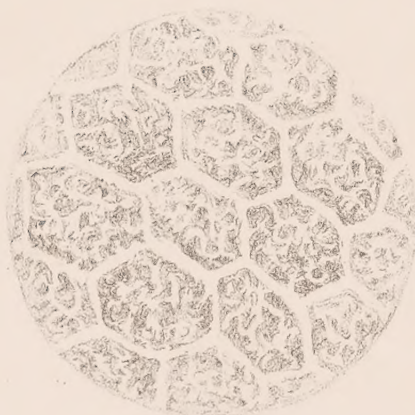


Fig 11.



Fig 12.



Fig 5.

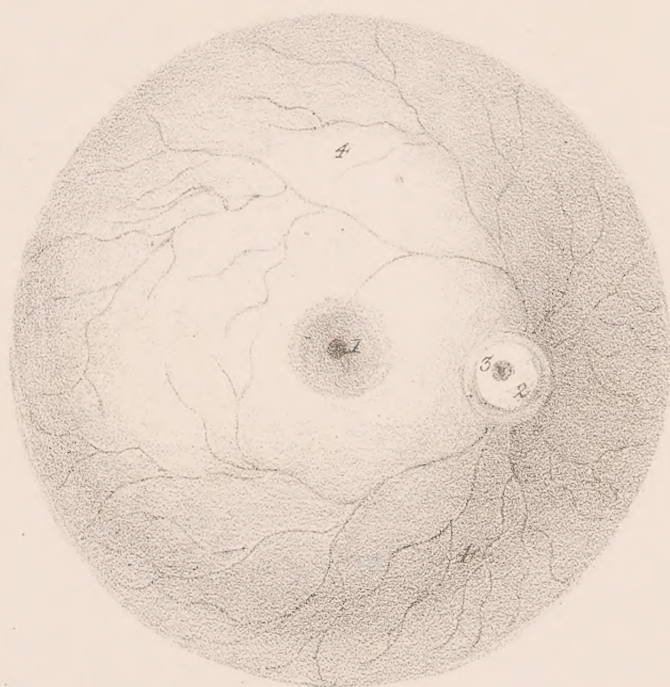


Fig 8.

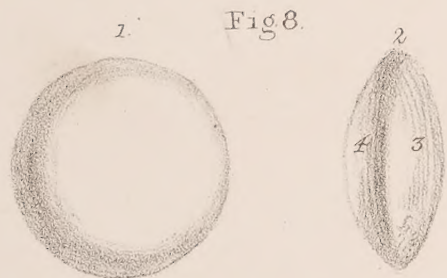


Fig 10.



Fig 4.

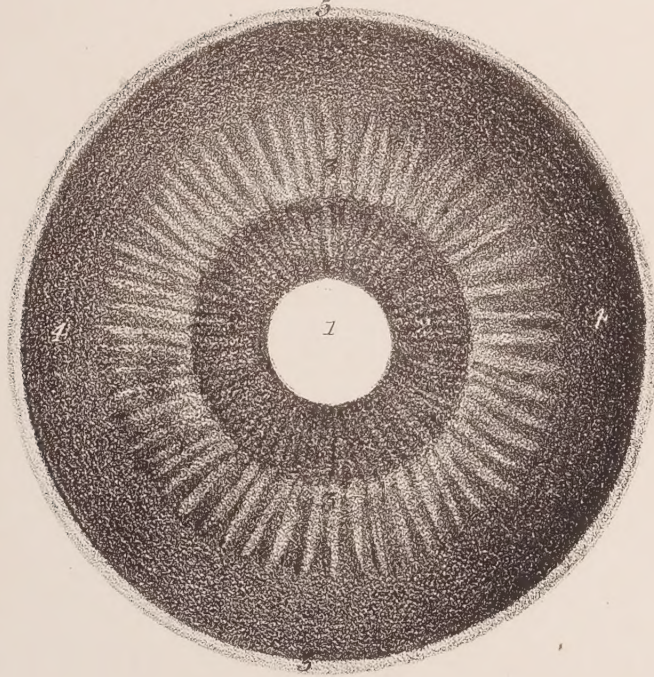


Fig 9.



Fig 3.



notice of the cranial part, by describing the ophthalmic ganglion, the spheno-palatine, the naso-palatine, otic, and submaxillary ganglia with their branches.

Ophthalmic ganglion and its branches.—The ophthalmic ganglion (plate XXVII. E) is frequently called “lenticular” (lens or lenticula, a lentil-seed), and “ciliary” (ganglion ciliare) from the nerves which issue from it; it lies within the orbit, about midway between the optic foramen and the globe of the eye, and placed between the external rectus muscle and the optic nerve; it is very small, and not easily found, owing to its being embedded in the soft adipose tissue which fills up the interstices between the different parts within the orbit.

Its branches are the following:—From its anterior border from sixteen to twenty delicate filaments issue, which proceed forwards to the surface of the sclerotica, and pierce it through minute foramina: these are the *ciliary nerves*. In their course to the globe of the eye they are accompanied

PLATE XXXI.

The anatomy of the deep tunics of the eye.

Fig. 1. The second tunic of the globe of the eye seen from the front.

No. 1. The pupil. 2. The iris. 3, 3. The ciliary ligament. 4, 4. The choroid membrane. 5, 5. The ciliary nerves, which are seen converging from every point of the circumference of the globe towards the margin of the iris. 6, 6. The long ciliary arteries.

Fig. 2. The same view of the globe of the eye. The iris has been carefully divided near to the margin of its circumference and removed, in order to display the ciliary processes from the front, and their relation to the lens. The choroid ciliary ligament, and ciliary nerves and arteries, are the same as in the preceding figure.

Nos. 1, 1. The divided edge of the iris. 2, 2. The ciliary processes surrounding and overlapping the lens. 3. The crystalline lens.

Fig. 3. A posterior view of the iris and ciliary processes. In this preparation the globe of the eye has been divided transversely, and the vitreous humour and lens have then been removed.

No. 1. The pupil. 2, 2. The posterior surface of the iris, named from its dark colour, uvea. 3, 3. The ciliary processes. 4, 4. The internal surface of the choroid membrane. 5, 5. The divided edge of the sclerotic and choroid coats.

Fig. 4. A transverse section of the globe of the left eye, showing the internal surface of its posterior half.

Nos. 1, 1. The divided edge of the sclerotic coat, choroid, and retina. 2, 2. The internal surface of the retina. 3. The foramen of Sæmmering; the limbus luteus which surrounds it is rendered imperceptible by the shadow thrown by the side of the segment. 4. The fold of the retina which usually conceals the foramen of Sæmmering. 5. The extremity of the optic nerve, situated to the nasal side of the central axis of the globe of the eye, and pierced by the arteria centralis retinae. 6, 6. Ramifications of the arteria centralis retinae.

Fig. 5. The posterior surface of the retina seen from the exterior. The figure represents the left eye-ball.

No. 1. The foramen of Sæmmering surrounded by a yellowish halo, called limbus luteus. 2. The optic nerve, divided at its point of expansion into the retina. 3. The divided trunk of the arteria centralis retinae, occupying the centre of the optic nerve. 4, 4. The ramifications of the arteria centralis retinae upon the inner surface of the retina, forming its vascular layer; it is seen through the two external layers.

Fig. 6. A diagram representing the direction of the fibres in the anterior layer of the iris.

No. 1. The pupil. 2. The circular fibres occupying the central margin of the iris, and acting as a sphincter to the pupil. 3, 3. The radiating fibres, proceeding from the external border of the circular fibres to the periphery of the iris.

Fig. 7. A small portion of the membrana pigmenti of the choroid coat highly magnified, and drawn from nature. It is seen to be composed of regular hexagonal plates, having their tissue filled with granules of colouring matter separated by interstices. The membrana pigmenti is formed by several laminae of these plates, which are largest upon the free surface of the membrane, and smaller towards the choroid.

Fig. 8. No. 1. A front view of the crystalline lens. 2. A side view of the crystalline lens. 3. Its anterior and least convex side. 4. Its posterior and most convex surface.

Fig. 9. The crystalline lens, marked by three lines, which become apparent after death, or after immersion in boiling water. These lines denote a tendency in the lens to split into three segments.

Fig. 10. A lens split into three segments after immersion in boiling water. The faces of the segments show the concentric laminae of which the lens is composed. The nucleus is observed in one of the segments, and the corresponding depressions in the other two.

Fig. 11. The iris and membrana pupillaris of a foetus six months and a half old, highly magnified. (After Cloquet.)

Nos. 1, 1. The extremities of the two long ciliary arteries. 2, 2. The arterial circle formed around the circumference of the iris. 3. The iris. 4. The membrana pupillaris. 5, 5. The arterial loops formed between the two layers of the membrana pupillaris. The centre of the membrana pupillaris has no appearance of vessels.

Fig. 12. The iris of a foetus at the eighth month, showing the mode of rupture of the membrana pupillaris, and the retraction of the vascular loops. The references are the same as in the preceding figure.

by one or two filaments derived from the nasal nerve, but they do not form a plexus or an interlacement: they become, however, disposed or divided into two fasciculi, one above, the other below the optic nerve, the latter being the more numerous. They pass along between the choroid membrane and the contiguous surface of the sclerotica, lodged in grooves in the latter; and on reaching the ciliary ligament they pierce it, some few of them appearing to be lost in its substance, whilst all the rest pass inwards, and ramify in the iris.

The posterior border of the ganglion, which seems as if terminated by two angles, receives two branches, of which one passes downwards and forwards from the nasal branch (4) of the ophthalmic nerve: the other branch is shorter than the preceding, and is derived from the inferior oblique branch (7) of the motor nerve of the eye: it joins the postero-inferior angle of the ganglion. A third branch (i) reaches the ganglion usually in company with the long or upper root, which appears to be the medium of communication with the rest of the gangliac system, being derived from the carotid or cavernous plexus.

Spheno-palatine ganglion and its branches.—The spheno-palatine, or Meckel's ganglion (plate XXVII. G), is very deeply seated, being placed in the pterygo-maxillary fossa, close by the spheno-palatine foramen; its size is small, its colour reddish, and form variable, being sometimes triangular, but still convex upon its outer surface; sometimes it is heart-shaped. Its branches may be divided into the following sets; superior, inferior, internal, and posterior.

The superior branches are two (plate XXVII. l), which pass downwards from the superior maxillary nerve as it passes across the pterygo-maxillary fossa previously to its entrance into the infra-orbital canal.

The *inferior* or *descending* branches (plate XXVII. m) are three: they form the *palatine* nerves, which are so called from their destination.

The *great* palatine nerve passes directly down, to reach the posterior palatine canal. In its descent, whilst in the canal, one or two small filaments are sent off through the nasal plate of the palate bone, and ramify in the pituitary membrane; these lie between the inferior and middle turbinated bones; but lower down a small branch is given off, which, after passing through a similar osseous foramen, enters the velum palati and the amygdala. Finally, after having passed through the canal, the nerve turns forwards beneath the arch of the palate, where it divides into two branches, which ramify in the soft structures of the palate and gums, where they communicate with the terminal filaments of the naso-palatine ganglion.

The *middle* palatine nerve descends parallel with the preceding, but in a separate canal, which opens before the hamulus of the pterygoid process. The nerve on reaching this point divides into three or four filaments, which ramify in the soft palate and tonsil. The *small* palatine nerve runs in a similar direction, but farther back, and is distributed to the same parts.

The *internal* or *spheno-palatine* branches (plate XXVII. n), three or four in number, pass inwards through the foramen from which they take their name, to reach the nasal fossæ. Two or three of these run upon the spongy bones; the other (k) from its destination is named "naso-palatine;" it passes obliquely downwards and forwards along the septum, and reaches the upper orifice of the anterior palatine canal, where it terminates in the *naso-palatine ganglion* (F). This ganglion is very small, and placed in the anterior palatine canal; it is a single or azygos ganglion, and receives by its upper border the naso-palatine branch of each side, which converge to it; it gives off two or three small filaments, which descend to the membrane of the palate.

Vidian nerve.—The *posterior* branch of Meckel's ganglion is called pterygoid, or Vidian (plate XXVII. o); it passes back through the pterygoid or Vidian canal in the base of the process of that name. Having reached the foramen lacerum basis cranii, it divides into two branches, one of which (p) inclines downwards and outwards, and enters the carotid canal, where it terminates in the carotid plexus, and so connects the spheno-palatine ganglion with the first cervical: the other branch (q) enters the cranium, but does not pierce the dura mater. It runs outwards and backwards beneath that membrane, lodged in a groove on the upper surface of the pars petrosa, and having passed through the hiatus Fallopii, reaches the aquæductus Fallopii, where it becomes applied to the inferior surface of the facial or portio dura nerve (12, 13), which it accompanies to within two lines or so of its exit from the stylo-mastoid foramen. The Vidian nerve at this point turns forwards into the tympanum, where it runs between the long process of the incus and the handle of the malleus, assuming the name of *chorda tympani* (r). In the next place the nerve descends, and escapes through the Glasserian fissure, inclining at the same time forwards and inwards, so as to come into contact with the gustatory nerve (29), which it accompanies along the inferior maxilla, until it approaches the sub-

maxillary gland. When near the gland, the chorda tympani (s) separates from the gustatory nerve, and descends upon the gland, and terminates in a small ganglion (H) placed upon that body.

The *submaxillary* ganglion (plate XXVII. H), so called from its position and relations, rests upon the gland just named; it is very small; receives the Vidian nerve at its posterior border, and two filaments from the gustatory nerve at its upper side; also one or two filaments from the sympathetic nerve, accompanying the facial nerve, pass upwards to join it. Two sets of filaments pass forwards from the ganglion; one joining the gustatory nerve, the other accompanying the duct of the submaxillary gland.

The Vidian nerve is here described as a continued thread extending from Meckel's ganglion to the submaxillary ganglion: this is done merely to give precision to its description and anatomical relations. But it is not to be thence inferred that it has no connexion with the portio dura and gustatory nerves, for in most dissections filaments appear to pass from the one to the other; neither has any question been raised as to the function of this nerve, or of the other branches of Meckel's ganglion.

The Otic ganglion.—This body (plate XIII. fig. 1, l; *ganglion oticum*, v. *auriculare*) was discovered by Dr. Arnold of Heidelberg, and is sometimes named after him. It is a small reddish-gray, soft ganglion, situated a little below the foramen ovale, on the inner side of the third division of the fifth nerve, nearly at the point where its motor or smaller root joins the larger or sensitive one. Thus, whilst its outer side is supported by the nerve, the inner is in relation with the cartilaginous part of the Eustachian tube, and the origin of the circumflexus palati muscle; and the middle meningeal artery lies behind it. To the ganglion filaments are traced from three sources, which may be considered as its roots; 1st, from the fifth nerve, particularly its smaller division (k), also from its internal pterygoid branch (m); 2nd, from the sympathetic system a filament (o) joins it, derived from the plexus that surrounds the middle meningeal artery; 3rd, the small petrosal branch (q) prolonged from the tympanic branch of the glosso-pharyngeal nerve, the course of which has been indicated in the description of the last-named nerve. From the ganglion, a branch (p) passes backwards and upwards to the tensor tympani muscle, another obliquely forwards to the tensor palati, and two (n) descend to anastomose with the anterior auricular nerve. (Arnold.)

Thoracic ganglia and plexus.—The thoracic portion of the sympathetic nerve (plate XXVII. L, L, M; plate XXVIII. A, B, C) comprises, first, a series of ganglia, twelve in number, disposed in a regular series upon the heads of the ribs or in the intercostal spaces, and connected by short nervous cords passing from one to the other; secondly, of the plexus, formed along the middle line, for the supply of the heart and lungs by the sympathetic and pneumo-gastric nerves, which present this remarkable difference, that the pulmonary plexus is formed for the most part by the latter, and the cardiac by the sympathetic nerves. The latter will be noticed first, from their connexion with the ganglia of the neck, already described.

Cardiac plexus and ganglion.—The heart receives its nervous influence by branches derived principally from the cervical ganglia at each side, to which are added others from the vagus nerve and the recurrent. The nerves of each side communicate variously with one another; and all, by interlacing behind and upon the aorta, form a plexus from which filaments descend to the substance of the heart. The plexus, from its situation, may be called “aortic,” but from the destination is usually named “cardiac.” The interlacement between the nerves is so complex and diffuse that it is considered by Mr. Swan and others as divisible into portions, or separate plexuses, viz. “the right and left lateral cardiac, the ventricular and auricular.” By the cardiac nerves of each side an interlacement or plexus is formed behind the aortic arch, above the trunk of the right pulmonary artery,—plexus cardiacus magnus, profundus (plate XXVII. N). “Anastomosis illa valdè insignis, quæ inter utriusque lateris cardiacorum nervorum truncos sub aortæ curvaturâ paulò supra cor conficitur.”—Scarpa. At the concavity of the aortic arch, between it and the pulmonary artery, a similar interlacement exists; and in this situation, to the right of the ductus arteriosus, a gangliform enlargement is usually found, named by Wrisberg the cardiac ganglion (plate XXVII. S; *ganglion cardiacum*). It is rounded and elongated, from half to three quarters of an inch long; it appears soft, but is of moderate consistence; its colour is that of mother-of-pearl.

From this plexus three orders of filaments proceed; some (o*, o*) pass backwards, and join the pulmonary plexus, others (m*, p*) turn forwards, to gain the fore part of the aorta; but the descending branches, by far the most numerous, pass to the heart itself, where they are disposed in two sets, which take the course of the coronary arteries, and are thence termed the coronary plexus. The branches of the *right coronary plexus* (plate XXVII. Q) pass forwards between the aorta and the

pulmonary artery, and ramify on the right ventricle and auricle, the greater number of them being directed towards the right border of the heart, where they communicate with the branches of the posterior plexus. The *posterior coronary plexus* will be found to ramify on the inferior and posterior surface of the left ventricle and auricle. These nerves were at one time supposed to be confined to the arteries which they accompany; but the researches of Scarpa have clearly shown that they pass away from the vessels in many places, and enter the muscular structure of the heart.

Cardiac nerves.—The cardiac plexus receives at its upper extremity the cardiac nerves of each side derived from the sympathetic, and some branches from the pneumo-gastric and its recurrent.

The superior cardiac nerve (plate XXVII. x, x; *superficialis cordis*) commences by three or four filaments from the first cervical ganglion, and usually receives one or two from the trunk of the sympathetic nerve. It is very small and delicate; it descends along the neck behind the sheath of the vessels, taking the direction of the carotid artery; it crosses the inferior thyroid artery, forming a plexus upon it; it enters the thorax, crossing the subclavian artery, and is guided by the innominate to the aortic arch, where it terminates in the plexus. In its course the nerve anastomoses with the middle and inferior cardiac nerves, and with branches of the vagus and recurrent. In some instances the nerve is found to divide at the lower part of the neck into three branches, of which a very small one inclines inwards, and contributes to form a plexus round the inferior thyroid artery: some join the middle, or great cardiac nerve, whilst the remainder form with the recurrent nerve a plexus, from which branches descend to the great cardiac plexus. The middle cardiac nerve (plate XXVII. a*; *cardiacus magnus*) on the right side is the largest of the set; on the left it is sometimes wanting. It descends from the middle cervical ganglion, or from the trunk of the sympathetic, should the former be wanting; and after passing in front of the subclavian artery inclines backwards, to reach the posterior surface of the aortic arch, where it terminates in the cardiac ganglion. The *inferior* cardiac nerve (e*) arises from the last cervical ganglion, by several filaments which pass behind the subclavian

PLATE XXXII.

The anatomy of the external ear is here shown.

Fig. 1. The pinna of the left ear.

Fig. 2. The same ear, the cuticle having been removed to show the numerous openings of the sebaceous follicles in the cutis. These are particularly distinct in the fossa innominata and concha, and at the base of the lobulus.

Nos. 1, 1. The point of connexion of the pinna with the side of the face. 2, 2. The helix. 3. The commencement of the helix in the concha. 4. The anti-helix. 5, 5. The two superior branches of the anti-helix, which inclose the angular-shaped fossa, 6, the fossa scaphoides (f. navicularis). 7. The fossa innominata. 8. The tragus. 9. The anti-tragus. 10. The concha, divided into two parts by the commencement of the helix. 11. The entrance of the meatus auditorius. 12. The lobulus.

Fig. 3. The arteries distributed upon the pinna. The references to the component parts of the ear are the same as in fig. 2 or fig. 4.

No. 1. The temporal artery. 2, 2. Anterior auricular arteries, branches of the temporal: they supply the anterior border of the pinna. 3, 3. Branches from the posterior auricular artery, which pass through openings in the fibro-cartilage, and are distributed upon its external surface.

Fig. 4. The fibro-cartilage of the left ear.

Nos. 1, 1. The folded border of the fibro-cartilage which forms the helix. 2. The tubercle of the helix, which gives attachment to the superior anterior ligament of the pinna, and to the attrahens aurem muscle. 3. The fissure of the helix. 4. The elevation forming the anti-helix. 5. The scaphoid fossa, very deep in the fibro-cartilage. 6. The processus caudatus of the helix and anti-helix. It is separated from the anti-tragus, 7, by a lengthened fissure, which is closed in the undissected ear by ligamentous fibres. 8. The commencement of the helix, dividing the cavity of the concha into two parts, 9, 9. 10. The portion of the fibro-cartilage which supports the tragus. 11. The fissure of the tragus. 12. The semilunar notch of the concha. 13. The semilunar ridge of the meatus auditorius. 14. The fissure which separates the upper part of the cartilage of the meatus from the concha; it is completed in the undissected ear by the fibrous membrane of the meatus. 15. The inferior process of the cartilage of the meatus.

Fig. 5. The posterior surface of the fibro-cartilage.

Nos. 1, 1. The rounded border corresponding with the helix. 2. A depression corresponding with the superior ramus of the anti-helix. 3. A convex surface formed by the depression of the fossa scaphoides. 4. The processus caudatus of the helix and anti-helix. 5, 5. The convex surface corresponding with the cavity of the concha. 6, 6. Two tubercles upon the posterior surface of the concha, which give attachment to the posterior ligaments of the pinna, and to the tendons of the retrahens aurem muscle. 7. The tubercle of the helix. 8. The fissure between the tragus and concha, closed in the undissected ear by the fibrous membrane of the meatus. 9. The tragus. 10. The fossa of the tragus. 11. The semilunar ridge of the meatus. 12. The cartilage of the meatus auditorius. 13. The inferior process of the cartilage of the meatus.

Fig. 1.



Fig. 2.



Fig. 3.

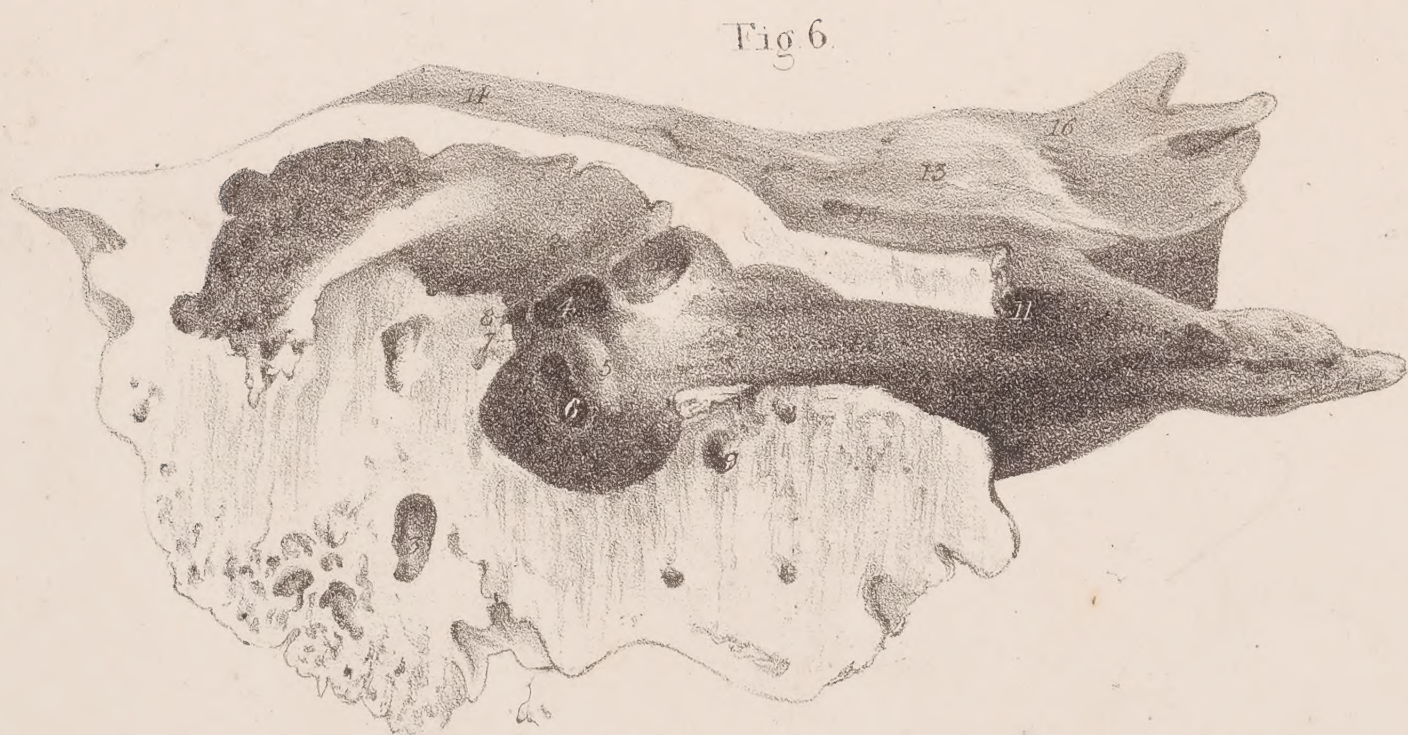
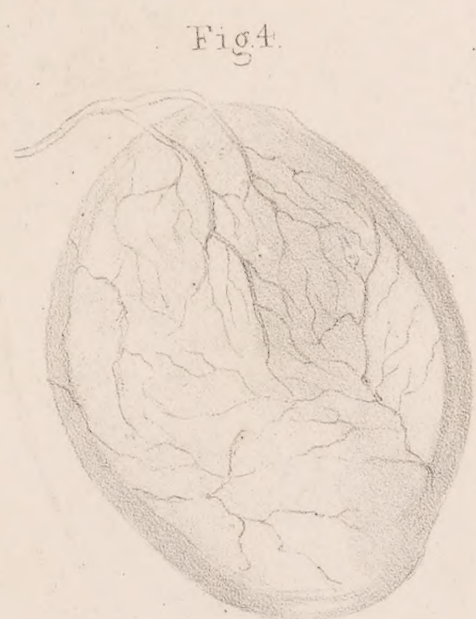
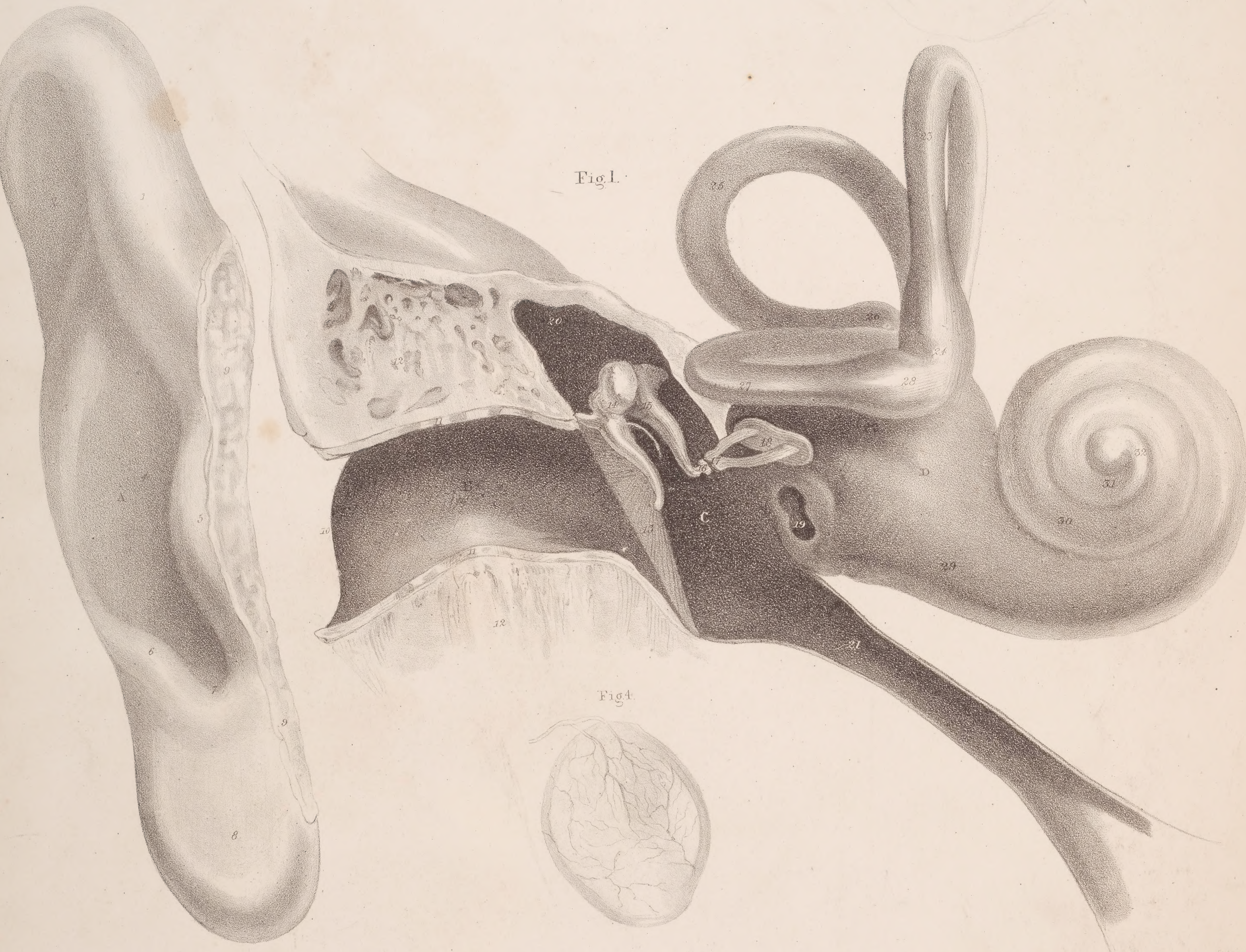
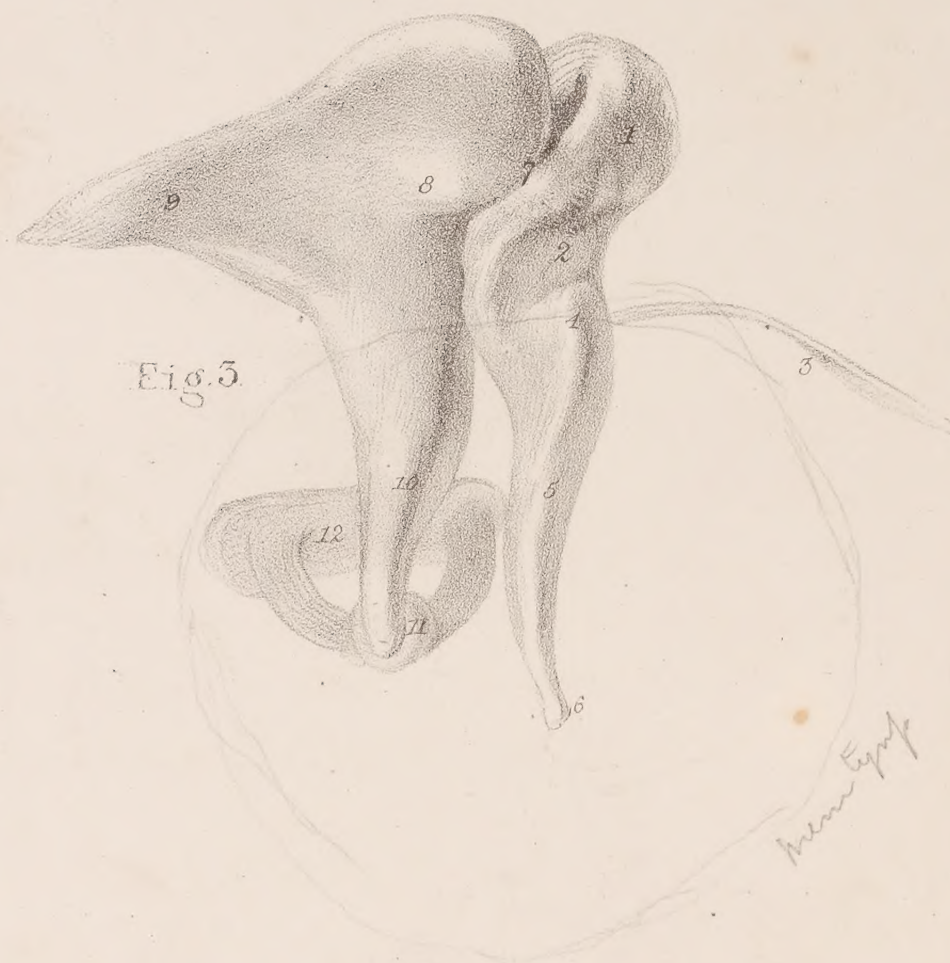
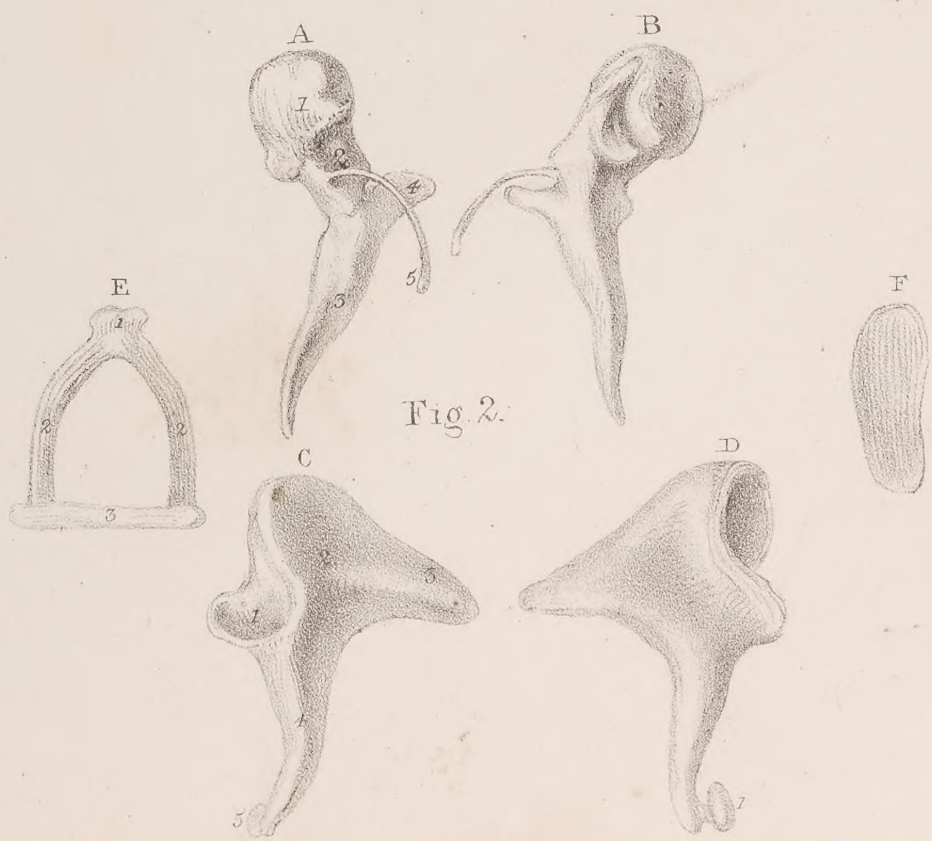


Fig. 4.



Fig. 5.





artery, but afterwards cross in front of the aorta, the greater number of its filaments reaching the anterior coronary plexus, the rest joining with the preceding. On the left side the inferior cardiac nerve is sometimes larger than the others. We have here described the nerves and the ganglia as we ordinarily find them. The names employed, being taken from a general average of cases, will be

PLATE XXXIII.

Anatomy of the organ of hearing: middle ear, or tympanum.

Fig. 1. A magnified view of the organ of hearing, showing its division into external, middle, and internal ear. The parts of which this drawing is composed are enlarged from nature.

A. The pinna of the right ear. B. The meatus. These two portions constitute the external ear.

No. 1. The anterior border of the helix. 2. The fossa scaphoides. 3. The anti-helix. 4. The concha. 5. The tragus. 6. The anti-tragus. 7. The semilunar notch of the concha. 8. The lobulus. 9, 9. The cut surface by which the pinna was connected with the face. 10. The margin of the meatus auditorius externus. 11, 11. The section of the integument which lines the meatus; the dark spots upon this surface represent sections of the ceruminous follicles. The interior of the meatus, B, will be observed to be studded with hairs, which are directed towards the centre of the canal. 12, 12. The divided surface of the petrous portion of the temporal bone.

C. The cavity of the tympanum crossed by the four small bones of the ear, the ossicula auditûs.

13. A section of the membrana tympani, divided through its middle. This membrane is concave externally, and convex within. 14. The malleus. 15. The incus. 16. The os orbiculare. 17. The stapes; the foot of the stapes. 18, closes the fenestra ovalis. 19. The fenestra rotunda leading into the cochlea. 20. The opening into the mastoid cells. 21. The Eustachian tube.

D. The labyrinth, or internal ear.

22. The vestibule. 23. The perpendicular semicircular canal. 24. Its ampulla. 25. The oblique semicircular canal. 26. Its ampulla. 27. The horizontal semicircular canal. 28. Its ampulla. 29. The commencement of the first turn of the bony canal of the cochlea. 30. The point of completion of its first turn. 31. The point of completion of its second turn. 32. The remaining half-turn, forming a slight expansion at its extremity, called the cupola. These two turns and a half constitute the cochlea.

Fig. 2. The small bones of the tympanum; ossicula auditûs, considerably magnified.

A. An anterior view of the malleus.

1. The articulating head of the malleus. 2. Its neck. 3. The manubrium, or handle. 4. The short process; processus brevis. 5. The long process; processus gracilis.

B. A posterior view of the malleus. Its divisions and processes are the same as in the preceding figure. C. A posterior view of the incus.

No. 1. The articulating surface which receives the head of the malleus. 2. The body of the incus. 3. Its short process. 4. Its long process. 5. The os orbiculare.

D. An anterior view of the incus. The points of reference are the same as in the preceding figure. The small rounded process, the os orbiculare, I, at the extremity of the long process, is more distinctly seen in this view.

E. A side view of the stapes.

No. 1. Its head. The constricted portion immediately beneath the head is the neck. 2, 2. Its two branches. 3. Its foot.

F. The foot of the stapes, seen by that surface which is received into the fenestra ovalis of the vestibule.

Fig. 3. The ossicula auditûs of the right ear, seen in their natural position when examined from the meatus. They are very much magnified.

No. 1. The head of the malleus. 2. Its neck. 3. The processus gracilis, or long process. 4. Its short process. 5. Its manubrium, or handle. 6. The apex of the handle, which is attached to the centre of the membrana tympani. 7. The articulation between the head of the malleus and incus. 8. The body of the incus. 9. The short process of the incus. 10. Its long process. 11. The articulation between the os orbiculare and stapes. 12. The stapes.

Fig. 4. This figure shows the distribution of arteries upon the fibrous layer of the membrana tympani. The drawing was made from the injected membrane in a foetus.

Fig. 5. The stapes enclosed by the mucous membrane of the tympanum, showing the arterial distribution upon its surface.

Fig. 6. A section of the petrous portion of the temporal bone, showing its inner wall.

No. 1. The irregular cavity forming part of the mastoid cells. 2. An elevated ridge formed by the canal of the aqueductus Fallopii. This canal gives passage to the facial nerve. It has been cut across in making the section, and the opening of the divided canal is seen at 3. 4. The fenestra ovalis. 5. The promontory. 6. The fenestra rotunda. 7. The pyramid, upon the posterior boundary of the tympanum. 8. The opening of entrance for the chorda tympani nerve. 9. Its opening of exit. 10. The termination of the canal for the tensor tympani muscle. 11. The commencement of its canal. 12. The canal of the Eustachian tube. 13. The anterior surface of the petrous portion of the temporal bone. 14. A prominence marking the situation of the superior semicircular canal. 15. A shallow depression leading to a small foramen, the hiatus Fallopii. This foramen gives passage to the petrosal branch of the Vidian nerve. 16. The notch upon which the fifth nerve lies, previously to forming the Casserian ganglion. 17. The termination of the carotid canal.

found not to agree with the distribution in certain cases. Upon this point, Mr. Swan* has very justly remarked, "If the sympathetic and its ganglia corresponded in different subjects, and gave off similar branches to form the cardiac nerves, it would be in every respect advantageous to have a specific name for each nerve; but as there is so much uncertainty, particularly as to the extent both of the prolongations of the sympathetic and its ganglia, and consequently as to the situation and number of the branches given off from these, it will be much less perplexing to the student, and quite as conducive to every useful purpose, to call all the nerves arising from the sympathetic and par vagum in the neck, and proceeding to the heart and its large vessels, the right and left lateral cardiac plexus."

The thoracic ganglia (plate XXVII. L, L, M; plate XXVIII. A, B, C), as has been said, lie on the heads of the ribs or in the intercostal spaces, covered by the pleura. Considering each of them as a centre from which branches proceed, we observe a branch of communication passing upwards to the ganglion above it, and downwards to that below it, so as to continue the series. Externally one, or, more commonly, two filaments (*i**, *i**) pass from each to the contiguous intercostal nerve, so as to connect the nerves of organic with those of animal life. The internal branches pass towards the middle line, some reaching the side of the trachea, and ending in the pulmonary plexus; others, ramifying on the œsophagus and aorta, form what may be called the thoracic plexus.

Splanchnic nerves.—Branches from the sixth to the ninth thoracic ganglia, and sometimes to the tenth inclusively, pass obliquely downwards and inwards on the sides of the bodies of the vertebræ, and unite into a single trunk (plate XXVIII. D; *nervus splanchnicus major*), which passes in a slight longitudinal fissure between the fibres of the crus of the diaphragm, and terminates in the semi-lunar ganglion (E). The anterior branches of the tenth and eleventh unite into a small nerve (F; *splanchnicus minor*), which pierces the crus of the diaphragm external to the larger nerve, with which it communicates by branches, and finally terminates in the renal plexus (G).

Abdominal ganglia.—The abdominal part of the sympathetic nerve consists of the semi-lunar ganglia and solar plexus, with the primary and secondary plexus which issue from them; and, secondly, of the direct continuation of the nerve. The former may be called the prævertebral part, from its position before the spine. Its ramifications are extensive and numerous, being diffused throughout the whole of the chylopoietic viscera, all of them being either immediately or remotely connected with the semi-lunar ganglia and solar plexus, from which their nervous filaments spread out like rays from a common centre. Their arrangement, however, is very easily understood by any one who recollects the distribution of the arteries to the viscera, inasmuch as these vessels support and conduct the nerves in their passage to the different organs. The nervous filaments interlace in their passage, so as to form a plexus previously to entering the substance of the organ; and the plexus is named from the parts within or upon which its ramifications are spread. The continuation of the nerve itself lies along the lumbar vertebræ at each side, representing those two lateral cords which are placed along the spine within the thorax.

Semi-lunar ganglia.—The semi-lunar ganglia (plate XXVIII. E) are two small reddish masses, placed upon the crura of the diaphragm, close beside the celiac artery. These are in the first place connected at their upper and outer borders with the great splanchnic nerves (D), which may be said to terminate in them—the point of junction being readily perceived by a marked difference of colour. The ganglia are connected by a transverse mass of similar structure, or are so close as to appear united at the lower surface of the celiac artery. The upper border of each ganglion is concave, the lower convex; hence their name "semi-lunar." But the two bodies so named, and in which the great splanchnic nerves terminate, form only a part of the nervous structure placed in this situation. The anterior border of each will be found connected with eight or ten smaller masses of a structure similar to themselves, which rest upon the crura of the diaphragm and the aorta, each being connected with the other by slips and by filaments, so as to enclose spaces. Now, to the aggregate of these islets of nervous substance the term *solar plexus* is applied, from which, as from a common centre of radiation, proceed filaments, accompanying the different arteries which spring from the aorta, constituting as many secondary plexus as there are organs to be supplied. These we shall arrange in the same order as the arterial branches:—

The *phrenic plexus* (sub-diaphragmatic) consists of filaments which accompany the phrenic artery. They will be found upon the crus of the diaphragm, passing upwards from the upper margin of the plexus; they are usually three or four, and very delicate; they form a slight interlacement with one another by small branches of communication, and with the phrenic nerve by a filament which joins

* A Demonstration of the Nerves of the Human Body, by Joseph Swan, p. 6.

it, or rather the terminal branch of it, which ends in the solar plexus. The phrenic plexus gives branches to the crura and broad part of the diaphragm.

The *cœliac plexus* consists of numerous large and close-set branches, which issue directly from the solar plexus, projecting forwards a little round the cœliac artery. Like the vessel just named, the plexus separates into three divisions, following the coronary, hepatic, and splenic arteries.

The *coronary* or *stomachic plexus* (plate XXVIII. 8) consists of numerous filaments, which are enclosed within the small omentum, and are guided by the coronary artery to the stomach. They form an interlacement, by branches of communication one with the other, also with the terminal branches of the pneumo-gastric nerves, and finally spread out upon both surfaces of the stomach.

The *hepatic plexus* (plate XXVIII. 10) consists of a great number of branches, which accompany the hepatic and portal vessels, enclosed like them within the small omentum. These branches form a complex interlacement, which is joined by some filaments from the pneumo-gastric nerve. The greater part of the plexus reaches the transverse fissure of the liver, and there enters its substance, into which they can be traced for some way, apparently more connected with the arteries than with the veins. Another part of the plexus takes the course of the pyloric artery, and descends to the right extremity of the stomach. And a third set of filaments, following the gastro-duodenalis, reaches the under surface and the great curvature of the stomach. Some of these incline outwards into the duodenum, and backwards to the pancreas, in company with the ductus choledochus. The cystic artery is also attended by some delicate branches, which ramify in the gall-bladder.

The *splenic plexus* (plate XXVIII. 9) consists of comparatively few branches, and the interlacement which they form is not so close as in the preceding instances. It accompanies the splenic artery, and gives off several filaments to the pancreas. Previously to its entering the spleen, some branches are reflected from it, along the vasa brevia, to the great curvature of the stomach.

The *aortic plexus* (plate XXVIII. l, l) is the direct continuation of the solar; its branches form upon the aorta a complex net-work, which can be traced along the iliac vessels; its principal offsets are the following:—The *superior mesenteric plexus* (11) is a broad, expanded, and complex interlacement of nervous filaments, enclosed between the layers of the mesentery, and accompanying the mesenteric artery to the small intestines on the one hand, and on the other to the cœcum and colon, guided by the colic arteries. The *inferior mesenteric plexus* (m) follows the inferior mesenteric artery: at its commencement its branches communicate with those of the preceding plexus, and towards its lower part, where it descends into the pelvis, it receives an increase from the nervous interlacement upon the iliac vessels; and farther down, where it becomes lodged between the layers of the mesorectum, it is connected with the hypogastric plexus.

The *renal plexus* (plate XXVIII. G) of each side differs from the preceding, inasmuch as it receives, in addition to the branches which follow the renal artery, the small splanchnic nerve (F). Its divisions accompany those of the artery to the fissure of the kidney. A minor plexus, similarly formed, passes to the supra-renal capsule.

The *spermatic plexus* consists at each side of some minute filaments, traceable from the renal plexus, and also from the aortic; they accompany the spermatic arteries in their course and distribution.

Lumbar ganglia.—Having traced the various ramifications of the prævertebral ganglia and plexus of the sympathetic nerves in the abdomen, we recur to the lateral cords. In the thorax we find the chain which they present at each side extended in such a way that the ganglia correspond with the heads of the ribs or the intervening spaces. When continued into the abdomen (which they enter by passing beneath the ligamentum arcuatum proprium), the two nerves incline forwards and inwards, so as to lie each along the inner border of the psoas muscle. The lumbar ganglia (plate XXVIII. H, H) vary much in number: there are usually, however, four or five. They are tapering, and also smaller than those in the thorax, their connecting branches being at the same time longer and more slender. From space to space branches (i, i) pass outwards from the ganglia, and, insinuating themselves under or between the fibres of the psoas muscle, join the anterior branches of the spinal nerves, which form the lumbar plexus. Another set of filaments (k, k) passes inwards in front of the aorta, and joins the aortic plexus, which they in this way contribute to form.

Sacral ganglia.—*Hypogastric plexus*.—From the last lumbar ganglion, at each side, nervous branches extend down over the border of the pelvis, inclining inwards as they descend upon the anterior surface of the sacrum. There are usually four, sometimes but three, sacral ganglia (plate XXVIII. L, L) at each side, with a terminal or azygos one (M) at the coccyx. The branches from the sacral ganglia proceed in opposite directions, like those of the preceding sets—some externally, to join

with the branches of the sacral plexus; others internally, which are of little importance, as they merely establish a communication with the parallel cord of the opposite side. The anterior filaments

PLATE XXXIV.

Organ of hearing: views of the tympanum and labyrinth.

Fig. 1. An internal view of the right temporal bone; the petrous portion has been sawn through its base and removed, in order to show the membrana tympani, with the relative position of the ossicula auditûs.

No. 1. The internal surface of the squamous portion of the temporal bone. 2. A groove formed by a branch of the arteria meningeæ media. 3, 3. Depressions and elevations corresponding with the convolutions of the brain. 4. The zygomatic process. 5. The styloid process; remarkably long in this bone. 6. The vaginal process. 7. The inner surface of the mastoid process. 8. The inner surface of the mastoid portion of the temporal bone. 9, 9. The groove for the lateral sinus. 10. The termination of the mastoid foramen in the groove for the lateral sinus. 11. The divided surface of the petrous portion of the temporal bone. 12. The opening of the aqueductus Fallopii upon the face of the section. 13. Part of the mastoid cells. 14. The opening of the mastoid cells into the tympanum. 15. The membrana tympani.

a. The malleus, in its relative position with regard to the membrana tympani. b. The processus gracilis projecting forwards. c. The long process of the incus. d. The short process of the incus projecting backwards. e. The foot of the stapes. f. The chorda tympani nerve. g. The chorda tympani nerve after its escape through the fissura Glaseri.

16. The fissura Glaseri. 17. Part of the glenoid fossa.

Fig. 2. The labyrinth of the right ear in its natural position; seen upon its anterior aspect.

No. 1. The inner wall of the tympanum. 2. The fenestra ovalis. 3. The fenestra rotunda. 4. The promontory.

A. The vestibule.

5. The superior or perpendicular semicircular canal. 6. Its ampulla. 7. The common tube formed by the union of the superior and middle semicircular canals. 8. The middle or oblique semicircular canal. 9. Its ampulla. 10. The inferior or horizontal semicircular canal. 11. Its ampulla.

B. The cochlea.

12. A slight depression marking the separation of the two canals of the cochlea. 13. The tubulus of the scala tympani. 14. The tubulus of the scala vestibuli. 15. The completion of the first turn of the cochlea. 16. The completion of its second turn. 17. The remaining half-turn, terminating in the rounded expansion called the cupola.

Fig. 3. The labyrinth of the right ear, in its natural position, viewed from behind.

A. The vestibule.

No. 1. The superior or perpendicular semicircular canal. 2. Its ampulla. 3. The common tube of the superior and middle semicircular canals. 4. The middle or oblique semicircular canal. 5. Its ampulla. 6. The inferior or horizontal semicircular canal. 7. Its ampulla. 8. The opening of the aqueductus vestibuli.

B. The cochlea.

9. The first turn of the cochlea. 10. The completion of the first turn. 11. The completion of the second turn. 12. The remaining half-turn. 13, 13. Numerous foramina through which the filaments of the auditory nerve enter the cochlea. This part corresponds with the termination of the meatus auditorius internus. 14. A part of the canal of the aqueductus Fallopii.

Fig. 4. The labyrinth of the right ear in its natural position, viewed from the meatus auditorius externus.

No. 1. The inner wall of the tympanum. 2. The fenestra ovalis. 3. The fenestra rotunda. 4. The promontory.

A. The vestibule.

5. The perpendicular semicircular canal. 6. Its ampulla. 7. The common tube of the perpendicular and oblique canals. 8. The oblique semicircular canal. 9. Its ampulla. 10. The horizontal semicircular canal. 11. Its ampulla.

B. The cochlea.

12. The commencement of its first turn. 13. Its first turn. 14. Its second turn. 15. The remaining half-turn, or cupola.

Fig. 5. The labyrinth laid open so as to display its internal cavity.

A. The internal cavity of the vestibule.

No. 1. The opening into the perpendicular semicircular canal. 2. Its ampulla. 3. The common tube of the superior and oblique semicircular canals. 4. The canal of the oblique semicircular canal laid open. 5. Its ampulla. 6. Its opening into the vestibule. 7. The horizontal semicircular canal. 8. Its ampulla. 9, 9. Its two openings into the vestibule. 10. The opening of the common tube of the perpendicular and oblique canals.

B. The cochlea.

11. The opening of the scala vestibuli into the vestibule. 12. A part of the fenestra rotunda. 13, 13. The scala tympani. 14, 14. The lamina spiralis.

Fig. 6. A vertical section of the cochlea in the dried bone.

No. 1. The cul-de-sac of the meatus auditorius internus. 2. The first turn of the cochlea near its commencement. 3, 3. The modiolus. 4, 4. The lamina spiralis.

Fig. 7. A vertical section of the cochlea in the fresh subject. The references are the same as in the preceding figure. It will be observed that the lamina spiralis is completed by the mucous membrane, which covers it so as to divide the canal into its two cavities; the superior, 5, 5, being the scala vestibuli, and the inferior, 6, 6, the scala tympani.

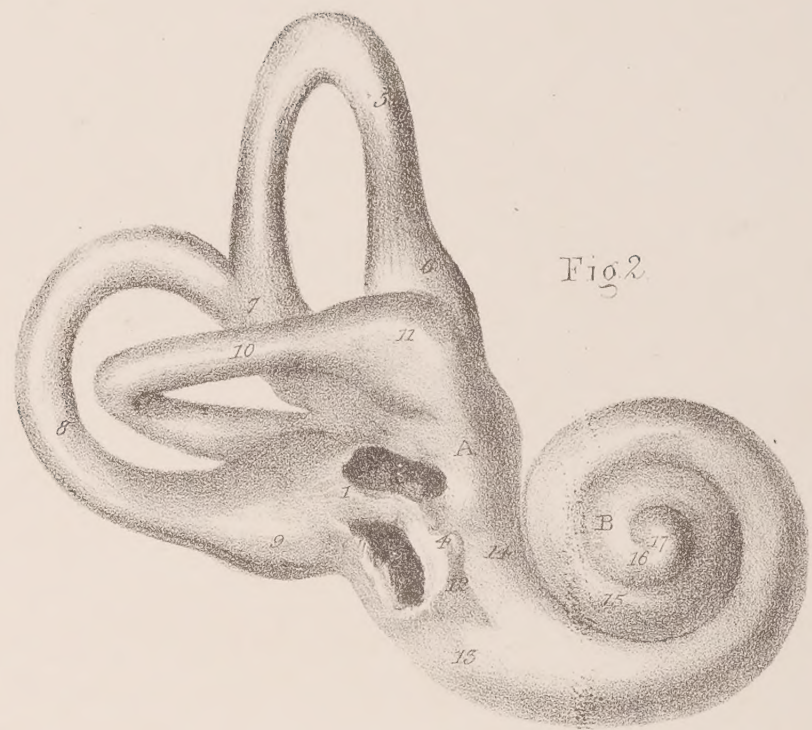
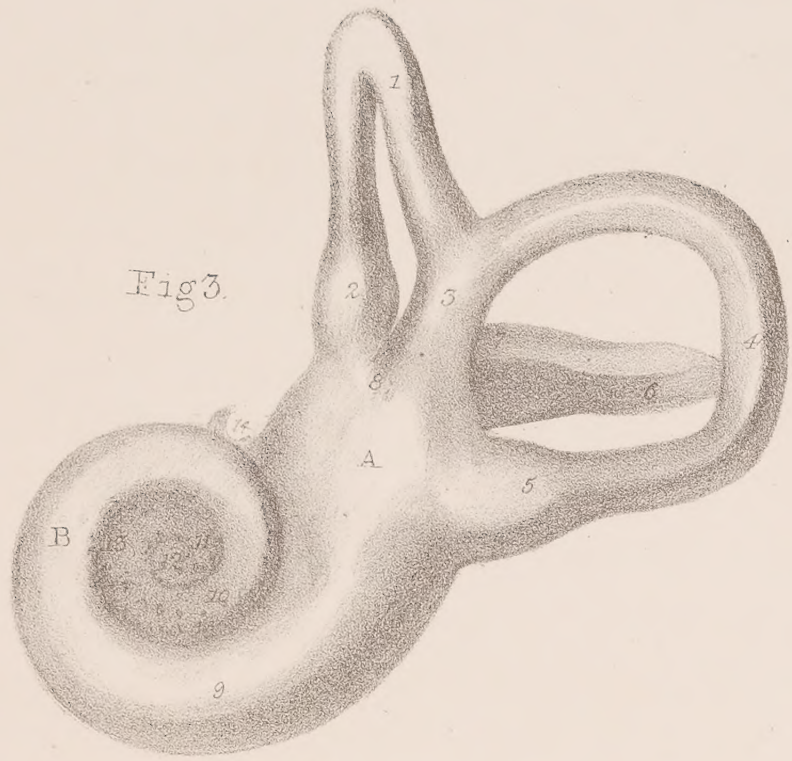


Fig 1.

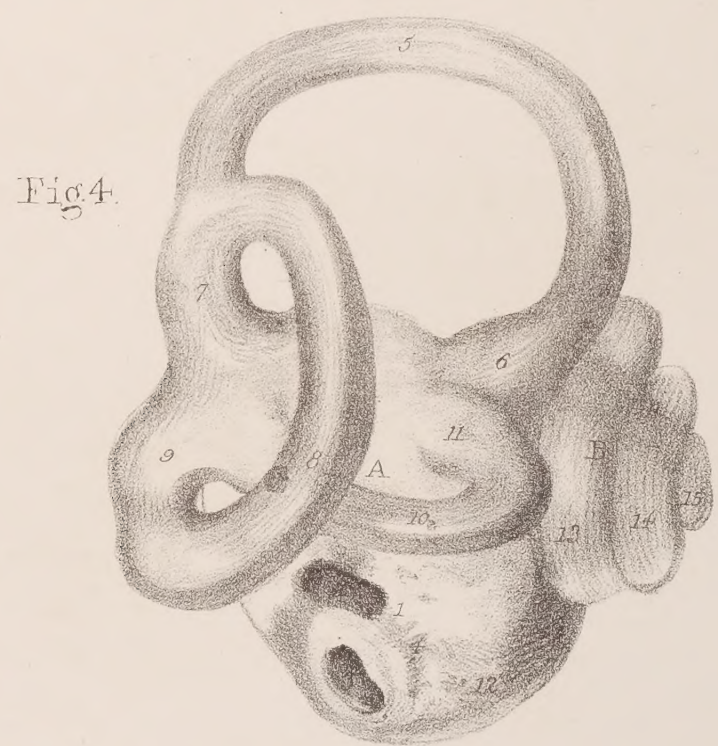
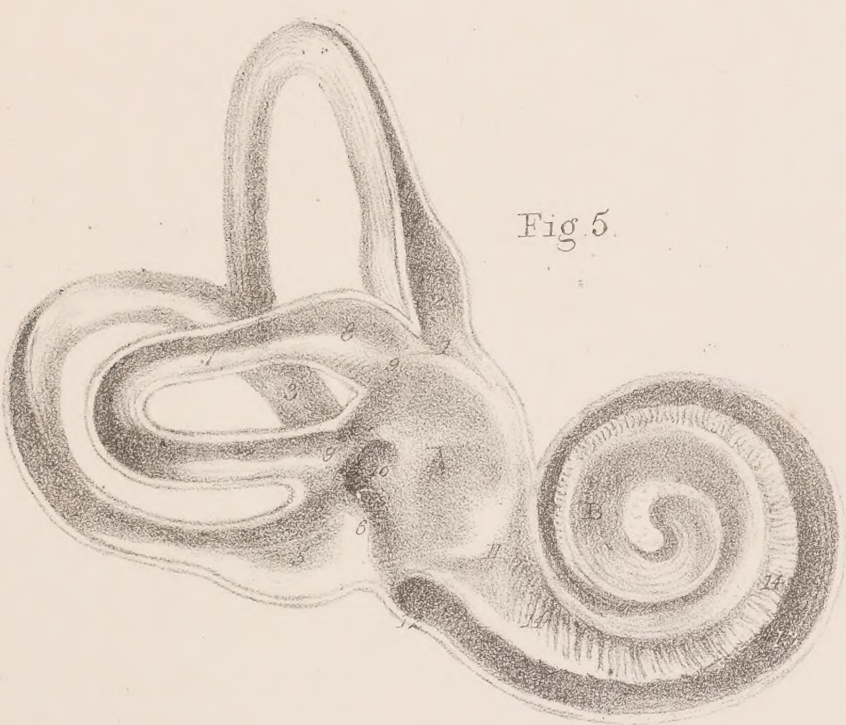


Fig. 1.



Fig. 3.



Fig. 2.

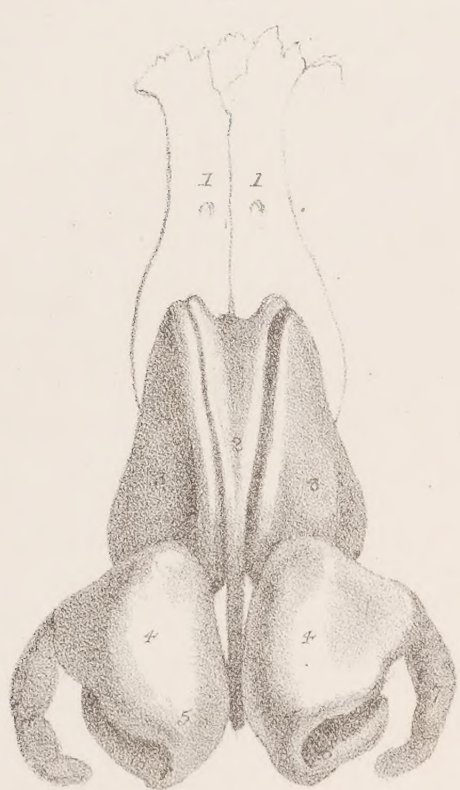


Fig. 4.



Fig. 8.

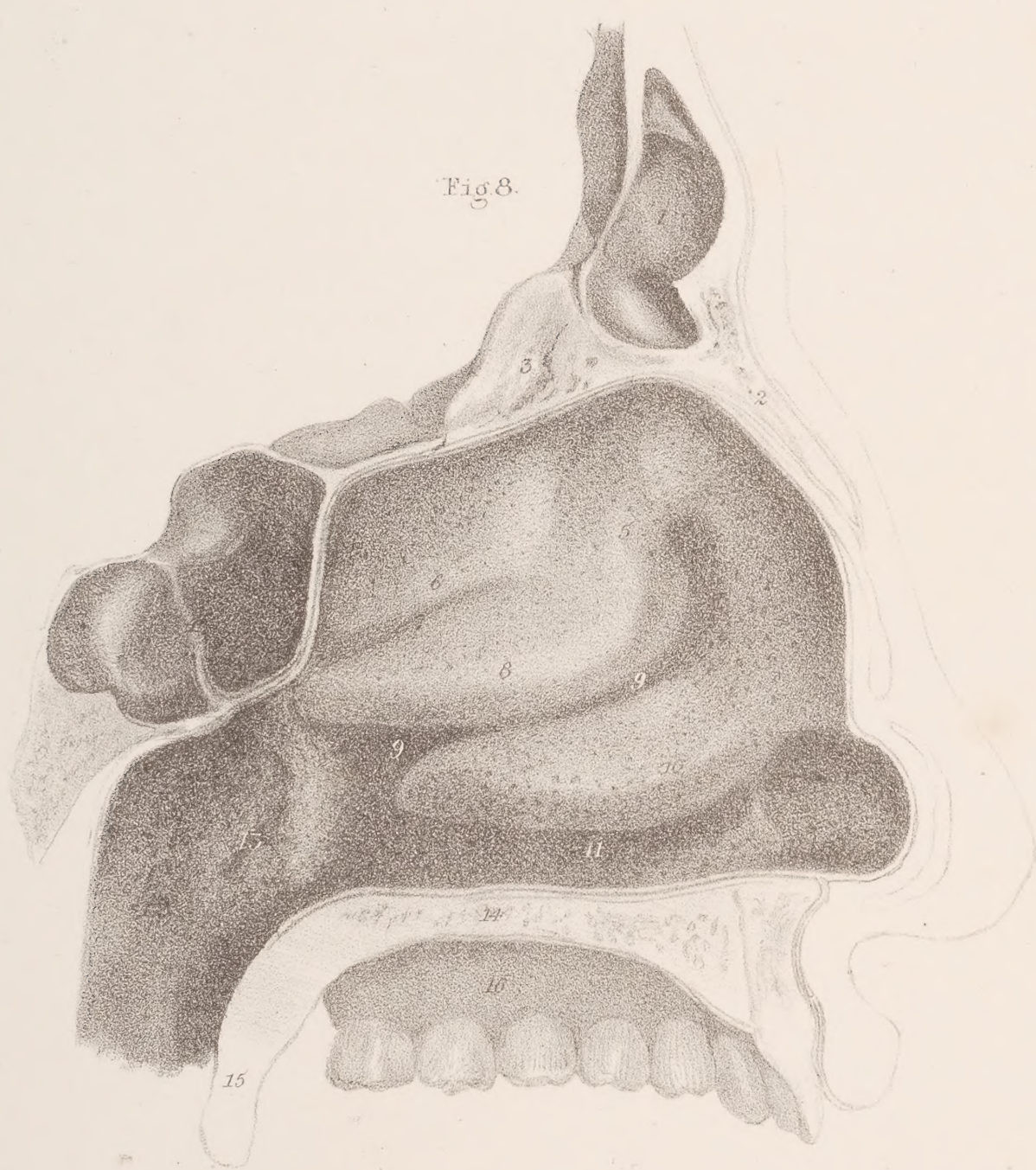


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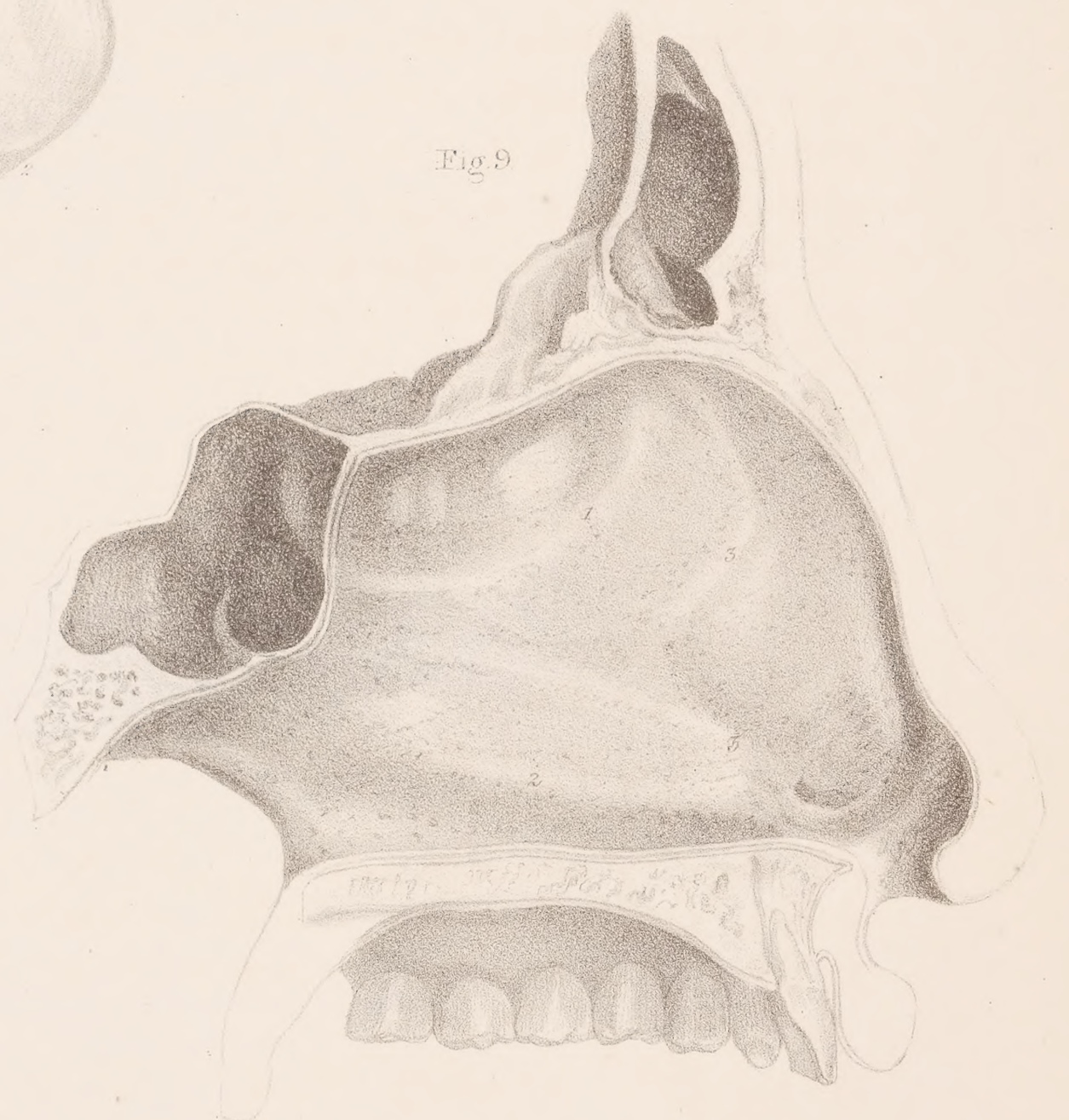


Fig. 5.



Fig. 7.

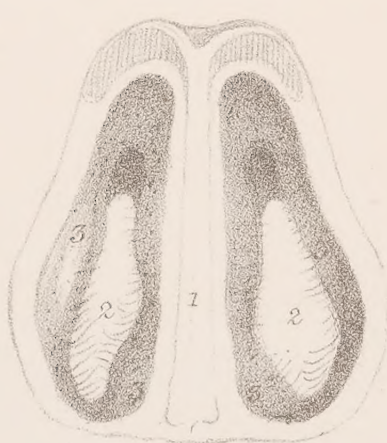
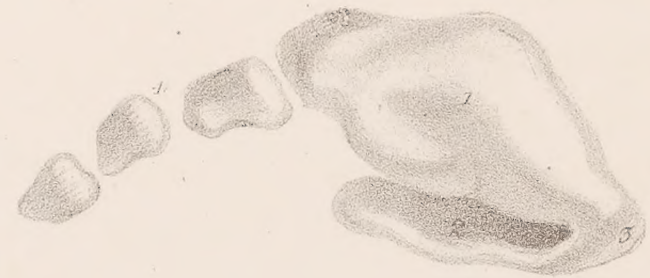


Fig. 6.



are numerous and important, as they contribute to form the *hypogastric plexus* (I), from which the pelvic viscera receive branches. This is a complex and extended interlacement, placed deeply in the pelvis, part of it being contained within the meso-rectum, where its fibres are continuous with those of the inferior mesenteric plexus, part in the false ligaments of the bladder, or in the broad ligaments of the uterus. In it we find a mixture of branches from nerves of both systems, viz. from the sacral ganglia, the inferior mesenteric, and aortic plexus; and in the next place from the vesical, uterine, and hæmorrhoidal nerves, derived from the spinal nerves (N, N; sacral plexus). The offsets from the hypogastric plexus follow the arteries in their course to the pelvic viscera, viz. to the rectum, bladder, vesiculæ seminales, uterus, vagina, &c.

ORGANS OF SENSE.

APPENDAGES OF THE EYE.

Before we proceed to examine the globe of the eye, we have to notice and describe certain accessory structures which are placed in relation to it, and are called its "appendages." All these are lodged either within the orbit, or in its immediate vicinity.

The appendages of each eye, in addition to the muscles, ophthalmic artery, vein, and nerves, comprise the eye-brow, eye-lids, and the lachrymal apparatus.

Eye-brows.—The eye-brows (plate XXIX. fig. 1; *supercilia*) are the arched ridges which surmount the upper border of the orbits, extending from near the root of the nose to the temples. They consist of integument, rather thickened, and studded with short hairs, which are inserted obliquely into it; also of a lamella of adipose tissue, and of the orbicularis and corrugator supercilii muscles. They form the boundary between the forehead and the eye-lids.

PLATE XXXV.

The organ of smell: the nose and nasal fossæ.

Fig. 1. The nose, deprived of its cuticle, in order to show the numerous openings of sebaceous follicles.

Fig. 2. The fibro-cartilages of the nose, seen from the front.

Nos. 1, 1. The nasal bones. 2. The antero-superior border of the cartilage of the septum. 3, 3. The two superior lateral cartilages. 4, 4. The two inferior lateral or alar cartilages. 5, 5. The projecting portions of the alar cartilages, which give form to the lobe of the nose. 6, 6. The internal portions of the alar cartilages. 7, 7. The cartilaginous plates which take the curve of the ala of the nose.

Fig. 3. A side view of the fibro-cartilages of the nose. The references are the same as in the preceding figure.

Fig. 4. The cartilage of the septum (cartilago septi), separated from the other cartilages, and viewed from its right side.

No. 1. The antero-superior border, against which the lateral cartilages rest. 2. The antero-inferior border, which is in relation with the columna. 3. The postero-superior border, which unites with the central lamella of the ethmoid bone. 4. The postero-inferior border, which unites with the vomer.

Fig. 5. The alar cartilage of the right side, seen from within.

No. 1. The external portion of the cartilage. 2. Its internal portion. 3. The projection corresponding with the lobe or tip of the nose. 4. The small cartilaginous plates which form the curve of the ala.

Fig. 6. The alar cartilage of the right side seen from the exterior. The references are the same as in the preceding figure.

Fig. 7. A transverse section of the nose at about its middle, showing the openings of the nares from within.

No. 1. The section of the cartilage of the septum. 2, 2. The openings of the nares. 3, 3. The mucous membrane lining the internal surface of the nose, upon which are seen short hairs (vibrissæ), and the openings of sebaceous follicles.

Fig. 8. A longitudinal section of the nasal fossa of the left side, showing its external wall.

No. 1. The frontal sinus. 2. The nasal bone. 3. The crista galli process of the ethmoid bone. 4. The sphenoidal cells. 5. The external wall of the nasal fossa covered with mucous membrane. The whole surface of the membrane is studded with the openings of mucous follicles. 6. A convex projection produced by the superior spongy bone. 7. The superior meatus. 8. The projection of the middle spongy bone. 9, 9. The middle meatus. 10. The projection of the inferior spongy bone. 11. The inferior meatus. 12. The upper part of the pharynx. 13. The opening of the Eustachian tube. 14. The section of the bony palate. 15. Section of the velum pendulum palati. 16. The roof of the palate.

Fig. 9. A longitudinal section of the nasal fossæ, made a little to the right of the middle line, in order to show the septum narium covered by its mucous membrane.

The references to the surrounding points are the same as in the preceding figure.

No. 1. That portion of the septum formed by the central lamella of the ethmoid bone. 2. A slight projection produced by the vomer. 3, 3. A slight ridge marking the union between the central lamella of the ethmoid bone and vomer and the cartilage of the septum. The whole surface of the mucous membrane is spotted with openings of mucous follicles.

Eye-lids.—The eye-lids (plate XXIX. figs. 1, 2, 3, 7; *palpebræ*) are two thin movable curtains placed in front of the eye, and calculated to conceal it, or leave it exposed, as occasion may require. The upper lid, which is larger and more movable than the other, has a muscle exclusively intended for its elevation, whilst the lower one is raised up only by the action of the inferior half of the orbicular muscle. They are joined at the outer and inner angles of the eye (fig. 2, Nos. 3, 4; *canthi*); whilst in the interval they are separated by a transverse slit (*fissura palpebrarum*). Externally, the lids are covered by integument, which is thin and delicate; internally, they are lined by the conjunctiva, which is more vascular than where it passes over the ball of the eye. Between these tegumentary membranes are placed the fibres of the orbicular muscle in both lids, and those of the levator palpebræ in the upper one, together with the tarsal cartilages, and along the margins of the lids the eye-lashes. The free margin of the eye-lids is straight (fig. 2, No. 4), and rounded towards the inner angle for a distance of about two lines and a half, the caruncula lachrymalis (7) being there interposed between them. At the point just indicated, the borders of the lids become thicker at the same time that their surfaces become arched, the external one being convex, the internal concave, inasmuch as it rests on the convexity of the globe of the eye. Now the borders of the lids in all this part of their extent, which is about four-fifths of their breadth from within outwards, are slightly bevelled off, so that when closed they come into contact only at the outer or cutaneous line. By this conformation a triangular groove is produced, whose sides are formed by the free margins of the lids, and base by the globe of the eye. Along this the tears appear to be conducted towards the inner angle, where the ducts are placed to receive them. At the union of the straight with the arched part of each lid will be seen a very small elevation (fig. 2, Nos. 5, 5) pierced by a minute foramen (punctum), which leads into the lachrymal ducts.

Tarsal cartilages.—The tarsal cartilages (plate XXIX. fig. 6, Nos. 27, 28; fig. 7; *tarsi*) are two thin lamellæ of fibro-cartilage, placed one in each lid: the lower cartilage is narrow, about two lines in breadth, elongated, and nearly of equal breadth from side to side; that of the upper lid is four or five lines broad at the middle, but narrows to a point at the lateral margins. The ciliary, or contiguous margins of the cartilages, are rather thick, bevelled off as above stated, and covered by the conjunctiva, where it is continuous with the external tegument; but the opposite margins are thin and attached to the orbit through the medium of a thin cellulo-fibrous lamella (fig. 6, Nos. 5, 7), prolonged obliquely to its border, where it becomes continuous with the periosteum, and is called the broad ligament. The cartilages extend inwards no further than the puncta, and there they become connected with the fibrous lamellæ, into which the tendon of the orbicularis muscle divides; and externally they become gradually thinner, and are connected with a fibrous lamella, which attaches them to the margin of the orbit. These means of connexion are sometimes called ligaments (*ligamentum tarsi, internum et externum*).

Eye-lashes.—Along the margin of each eye-lid, at the line of junction of the skin with the conjunctiva, are placed two or more rows of hairs, called *cilia* or *eye-lashes*, (plate XXIX, fig. 1; fig. 2, Nos. 1, 2; fig. 6, No. 31). They are more closely set, and also longer, in the upper than in the lower lid, and at the middle of each than towards their angles; they become thin and scattered in the interval between the puncta and the inner commissure. They are curved in such a way that those of the upper lid present a convexity directed downwards and forwards—those of the lower, upwards and forwards, by which they come into apposition sufficiently for the protection of the eye, even before the lids come into close contact.

Meibomian glands (glandulæ Meibomii).—These are sebaceous follicles (plate XXIX. fig. 7) placed between the conjunctiva or lining membrane of the lids and the tarsal cartilages. They are very minute; their colour, or rather that of the secreted matter, being yellow, distinguishes them from the other structures. They are small culs-de-sac disposed in rows, running in parallel lines, and vertically from the attached to the free margin of each cartilage, along which they open by minute pores (fig. 2); the cartilages present grooves upon their surface corresponding with the rows of the follicles. There are usually from twenty to thirty of them in the upper lid, and about the same number in the lower.

Along the line of the eye-lashes, the external tegument of the lids changes its appearance and characters; it becomes thin and soft, so as to resemble mucous membrane. It is obviously prolonged from the free margin to the inner surface of the lids, and from these it is reflected over the fore part of the globe of the eye. Moreover, through the puncta and lachrymal ducts above alluded to, it is prolonged into the nasal cavity. At the inner angle or commissure of the lids, which is more open than the external one, the conjunctiva forms a fold, which encloses some fine cellular tissue, a delicate

plate of fibrous structure, and also some mucous follicles, which, together, may be said to represent a third eye-lid in a rudimentary form. These are known as the *plica semi-lunaris* and *caruncula lachrymalis*.

Plica semi-lunaris.—This is a small angular fold (plate XXIX. fig. 1; fig. 2, No. 6; fig. 4, No. 6) of the conjunctiva, seen resting on the globe of the eye, at the inner commissure of the lids; its base, which is concave, looks outwards, the apex inwards. About a line to the inside of its base rises up the *caruncula lachrymalis* (fig. 1; fig. 2, No. 7; fig. 4, No. 5). Its form is conical; its summit corresponds with the inner angle of the lids; it looks red and fleshy. It consists of a cluster of delicate mucous follicles, from which an unctuous matter exudes; upon the surface are seen some minute hairs. The *caruncula* is not unfrequently included amongst the lachrymal apparatus, from its being supposed to assist in directing the tears into the puncta: such, however, is not the use of the third lid, of which this is a rudiment.

Lachrymal apparatus.—The lachrymal apparatus consists of the lachrymal gland, puncta, and ducts, the lachrymal sac and its duct.

Lachrymal gland.—The lachrymal gland (plate XXIX. fig. 3, No. 5; fig. 4, No. 7; fig. 5) is placed at the upper and outer part of the orbit, near its anterior border, corresponding with the lachrymal fossa in the orbital plate of the frontal bone. The gland is convex upon its upper surface (fig. 5), where it is in apposition with the wall of the orbit, and with which it is connected by a fibrous lamella, described by Sœmmering as a ligament; its under surface (fig. 3, No. 5) is concave, where it rests upon the globe of the eye, the recti muscles (superior and external) interposing. Its length is three quarters of an inch, its breadth half an inch; the inner border is compressed and thin, the external one being a little thicker. The gland is divisible into two lobes, which are so closely connected that the line of separation (which is not complete) is not at first observed. When the cellular tissue which invests it is removed, it is at once perceived to belong to the class of conglomerate glands, being composed of a number of granules, each forming a secreting structure, which produces the tears. From the granules arise excretory ducts, which emerge from the gland at its anterior border, run downwards and inwards close to the conjunctiva, between it and the broad tarsal ligament, and open in a row upon its free surface (fig. 3, No. 6), about three lines above the upper margin of the tarsal cartilage; these ducts are usually seven in number.

Puncta lachrymalia and lachrymal ducts.—Where the external margin of the *caruncula* is in apposition with each lid, a minute foramen will be observed (plate XXIX. fig. 2, No. 5, 5; fig. 3, Nos. 4, 4; fig. 4, No. 1, 1; *punctum lachrymale*). The puncta are situated where the curved and straight parts of the lids meet, in the summit of a small papilla; they form the openings of two canals (fig. 4, Nos. 2, 2; *lachrymal ducts, canaliculi lachrymales*) which lead into the sac (3), or reservoir, for the reception of the tears. The superior canal is longer than the other: if a thin bristle be passed into it, it will be found first to ascend a little, and then to turn obliquely downwards and inwards. The inferior one descends a little, and then turns inwards with a very slight ascent: both open into the external and anterior side of the lachrymal sac, generally by two distinct orifices, which are close together, but sometimes by a common duct.

Lachrymal sac.—The lachrymal sac (plate XXIX. fig. 4; *saccus lachrymalis*) is a membranous reservoir, placed in a groove formed for it in the os unguis and nasal process of the superior maxillary bone, at the inner canthus of the eye. Its form is oval, terminating superiorly in a cul-de-sac, but inferiorly it is prolonged into a tube (4; the nasal duct); at its superior and external side it receives the lachrymal ducts. The sac is crossed by the tendon of the orbicular muscle, being at the same time covered by its fibres as well as by its reflected tendon. It consists of two layers of membrane, united by cellular tissue, one of which is a mucous lining continuous below with that of the nasal fossæ, and above with the conjunctiva, through the medium of the lachrymal ducts; and the other a thin fibrous membrane, serving at the same time as periosteum for the bone in which it is lodged.

Nasal duct.—The nasal duct (plate XXIX. fig. 4, No. 4; *ductus ad nasum*) is about six inches in length in the recent state, its direction being downwards, backwards, and a little outwards. Communicating above with the lachrymal sac, it terminates in the inferior meatus of the nose by an oblique slit or orifice, which is surrounded by a small fold of the pituitary membrane. It often appears as if constricted at the middle, at the same time that it presents a slight curve, whose convexity is turned forwards. The osseous structure here consists of the os unguis, the superior maxilla, and the inferior turbinated bone, which together form a complete canal.

GLOBE OF THE EYE.

The globe of the eye (plate XXX. fig. 1) is situated at the internal and anterior part of the orbital fossa, which lodges it and its appendages: its form is that of a spheroid, slightly compressed at the four opposite points of its circumference, which correspond with the insertion of the recti muscles (5, 6, 7). The direction of the axis of the globe of the eye does not correspond with that of the orbit; the axes of the eyes are parallel with one another, whilst those of the orbits diverge considerably in front, and if prolonged backwards would decussate behind the body of the sphenoid bone; hence as the optic nerves coincide in their direction with that of the axes of the orbits, each of them enters the globe of the corresponding eye to the inner side of its axis, and consequently of the axis of vision. When viewed in profile, the globe appears to be composed of segments of two spheres, of which the anterior (9) is smaller and more prominent; hence, when its

PLATE XXXVI.

The anatomy of the organ of taste: the tongue.

Fig. 1. The dorsum of the tongue, showing the papillæ.

No. 1. The epiglottis. 2, 2. The great cornua of the os hyoides. 3, 3. Folds of mucous membrane, called fræna epiglottidis, or glosso-epiglottidean ligaments. 4. The base or root of the tongue. 5, 5. Mucous glands covering the root of the tongue. 6. The raphé. 7. The apex or point of the tongue. 8, 8. The papillæ lenticulares (calyciformes, circumvallatæ), forming two rows upon the base of the tongue, which approach each other on the middle line. 9. The foramen cæcum. 10, 10. Papillæ fungiformes. 11, 11. Papillæ conicæ. 12, 12. Papillæ filiformes.

Fig. 2. Arrangement of the muscular fibres in a superficial dissection of the tongue, made according to the plan described by Gerdy.

No. 1. The epiglottis. 2. The greater cornua of the os hyoides. 3. The lesser cornua of the os hyoides. 4. An expansion of yellow elastic tissue spreading upon the dorsum of the tongue, and containing a number of mucous follicles, 5, 5. 6, 6. Median longitudinal fibres (superficial lingual muscle of Gerdy) attached posteriorly to the elastic tissue, and converging anteriorly towards the raphé. 7, 7. Superior fasciculi of the hyo-glossus muscle (chondro-glossi muscles). 8, 8. Lateral fasciculi of the hyo-glossus (cerato-glossi) passing between the two portions of the stylo-glossus, and spreading out along the border of the tongue. 9, 9. The hyo-glossus muscle. 10, 10. The longitudinal portion of the stylo-glossus muscle. 11, 11. Its transverse portion. The whole surface of the tongue is studded with small points,—the cut extremities of the perpendicular fibres which are inserted into the under surface of the mucous membrane.

Fig. 3. The superficial lingual muscle has been removed in this dissection in order to display the arrangement of the fibres in a deeper layer.

No. 1. The epiglottis. 2. The process of elastic tissue cut through. 3, 3. The great cornua of the os hyoides. 4, 4. The lesser cornua of the os hyoides. 5, 5. The hyo-glossus muscle at each side. 6, 6. The fasciculus of the hyo-glossus muscle which passes between the two portions of the stylo-glossus muscle, and encircles the lateral boundary of the tongue. 7, 7. The longitudinal portion of the stylo-glossus muscle. 8, 8. The transverse portion of the stylo-glossus muscle. 9. The follicular tissue mixed with fat. 10. The fibrous raphé of the tongue. 11, 11. Fibres of the transverse muscle interspersed with points which indicate the transverse division of vertical fibres.

Fig. 4. A view of the muscles upon the under surface of the tongue.

No. 1. The body of the os hyoides. 2, 2. The genio-hyo-glossi muscles divided from their attachment to the lower jaw. 3. The lingualis muscle (deep lingual of Gerdy) of the right side seen throughout its entire extent. 4. The lingualis muscle of the left side partly concealed by the hyo-glossus muscle. 5. The hyo-glossus muscle of the left side; the right has been removed. 6, 6. The longitudinal portion of the stylo-glossus muscle. 7, 7. The transverse portion of the stylo-glossus muscle. 8, 8. The mucous membrane of the tongue covered with papillæ.

Fig. 5. A transverse section of the tongue made near to its base.

Nos. 1, 1. The mucous membrane on the exterior. 2. The elastic tissue. 3, 3. The superficial lingual muscle. 4, 4. The vertical fibres, which are oblique in their direction at the base of the tongue. 5, 5. Fibres of the transverse muscle somewhat curved near the base of the tongue. 6. A fibro-cartilaginous plate developed in the fibrous tissue of the raphé. 7, 7. The divided fibres of the linguales muscles. 8. The two genio-hyo-glossi muscles.

Fig. 6. A transverse section of the tongue made near to its anterior third.

Nos. 1, 1. The mucous membrane. 2, 2. The superficial lingual muscle. 3, 3. The divided fibres of the linguales muscles. 4, 4. Vertical fibres. 5, 5. Transverse fibres. 6. The genio-hyo-glossi muscles. 7. A part of the central cartilaginous plate developed in the fibrous structure of the raphé.

Fig. 7. A papilla fungiformis and several papillæ conicæ highly magnified, showing the disposition of their capillaries; from Sæmmering.

Fig. 8. A. Papillæ filiformes, highly magnified. B. Transverse section of a papilla calyciformis; loops of capillary vessels are seen upon its surface.

No. 1. The papilla. 2, 2. The fissure of the cup in which it is lodged. Both of these figures are copied from Sæmmering.

Fig 2.

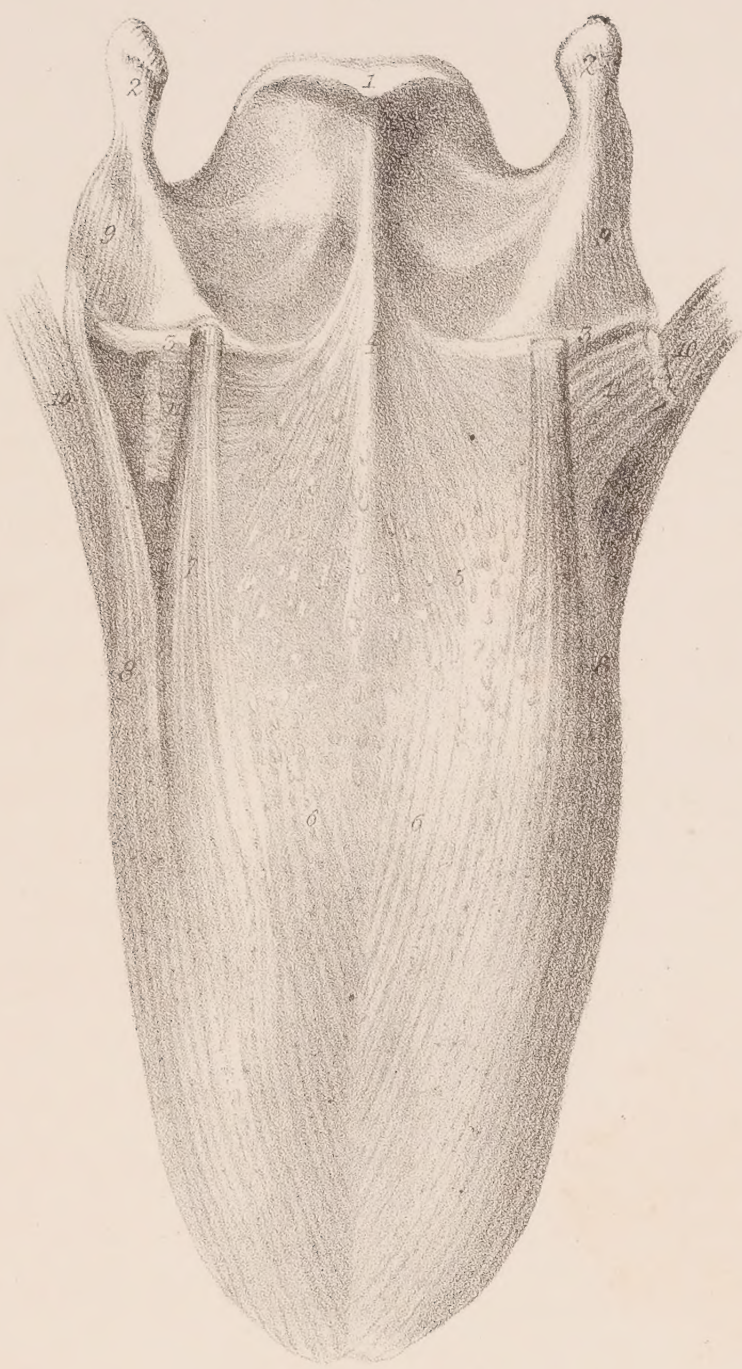


Fig 3.

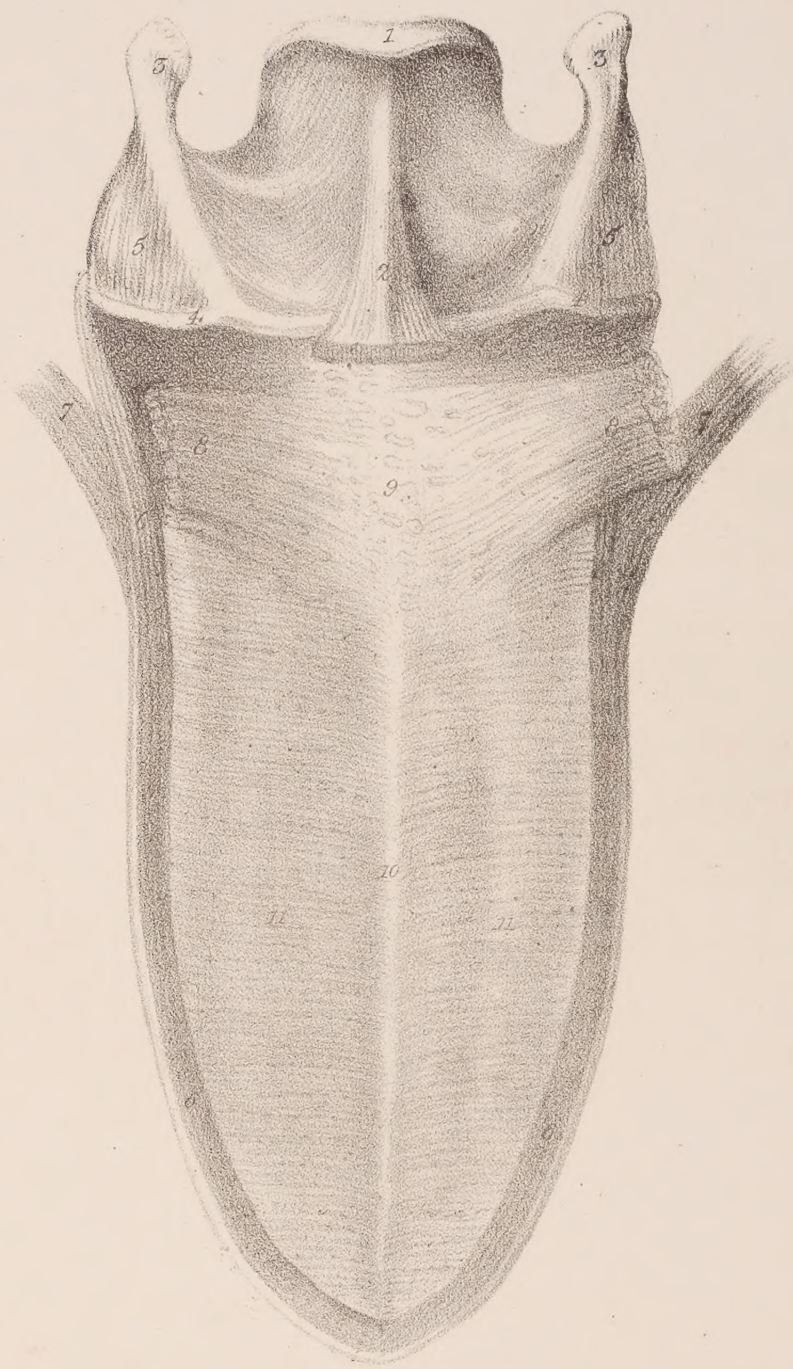


Fig 1.



Fig 5.



Fig 6.



Fig 7.



Fig 4.



Fig 8.



Fig 1.

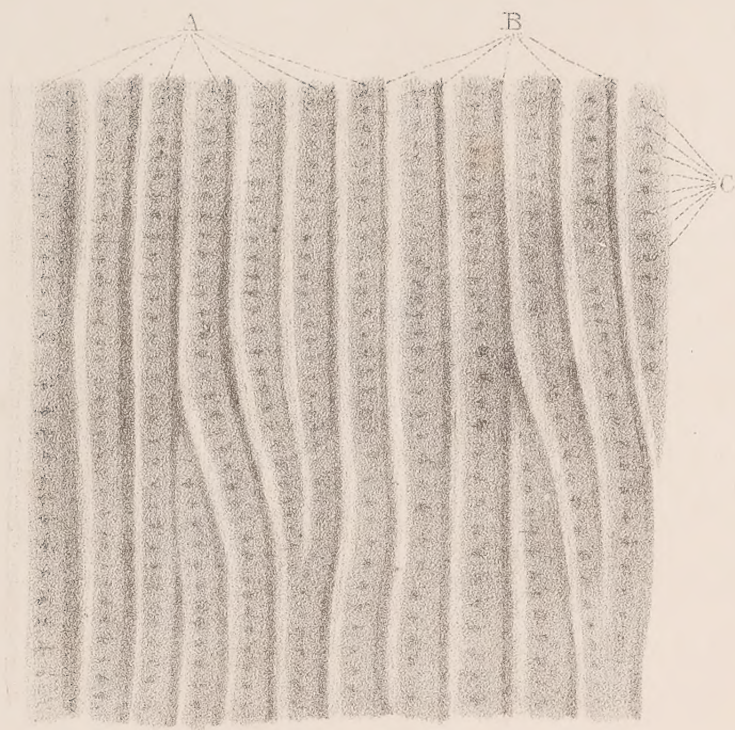


Fig 2.

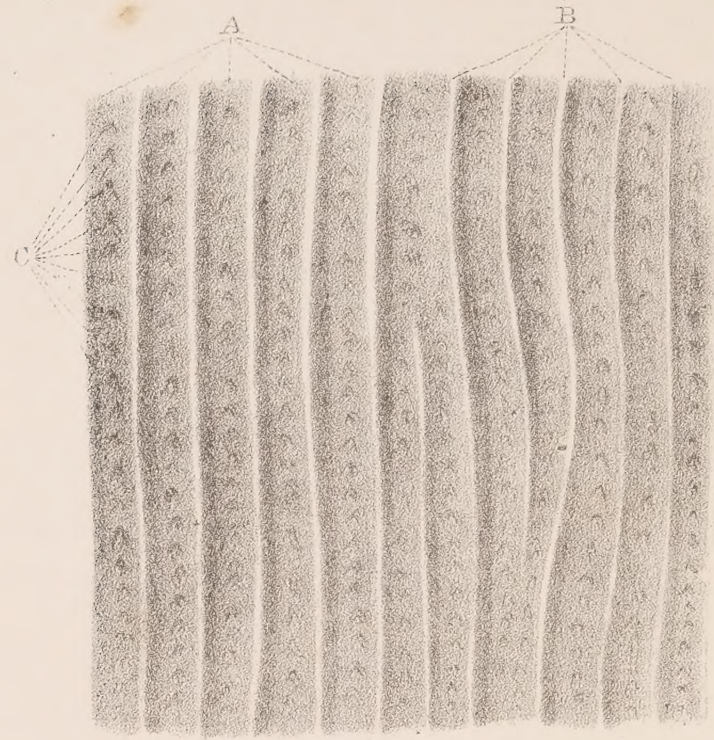


Fig 3.

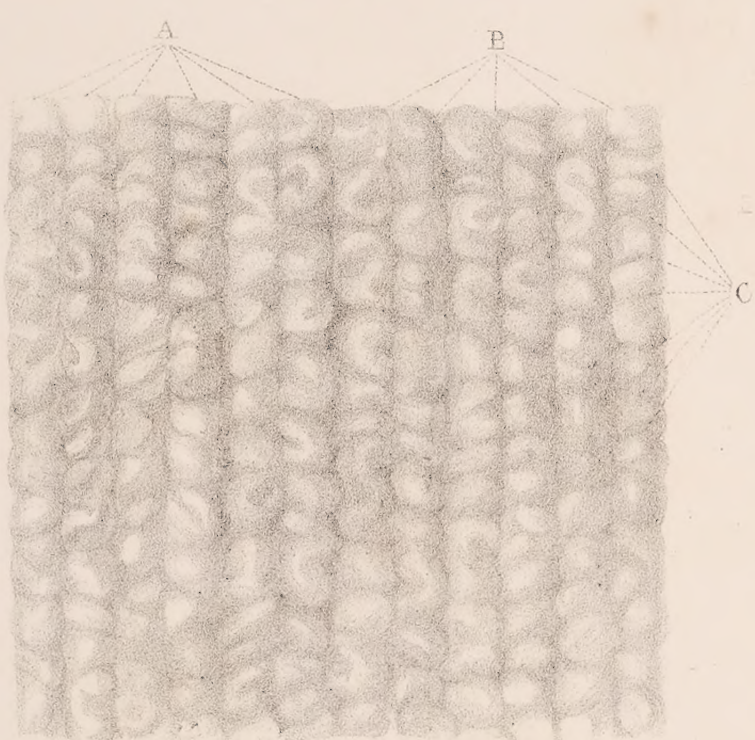


Fig 4.

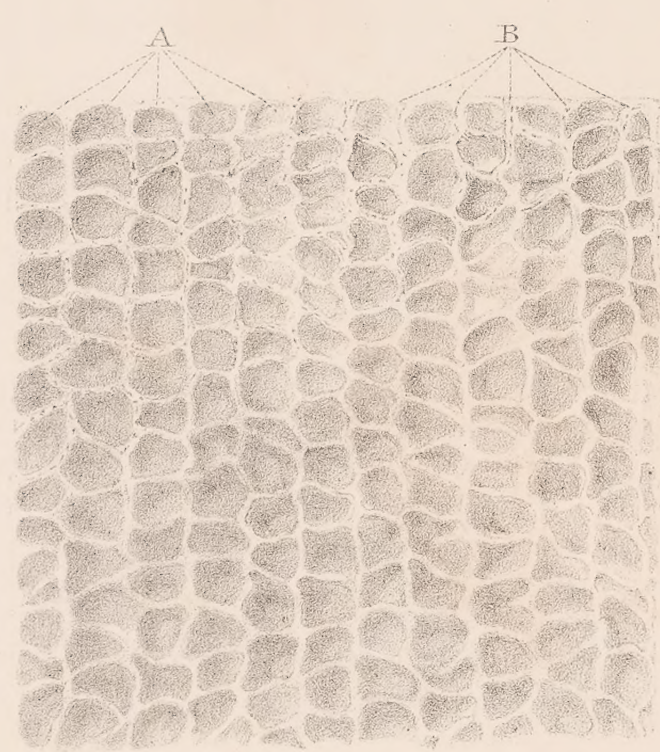


Fig 5.

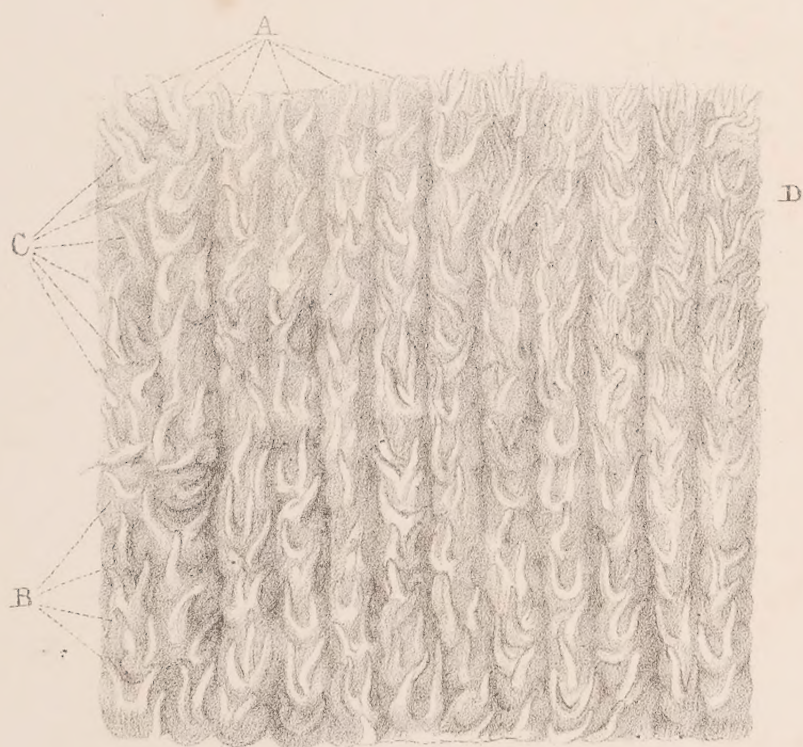


Fig 6.



Fig 8.



Fig 7.

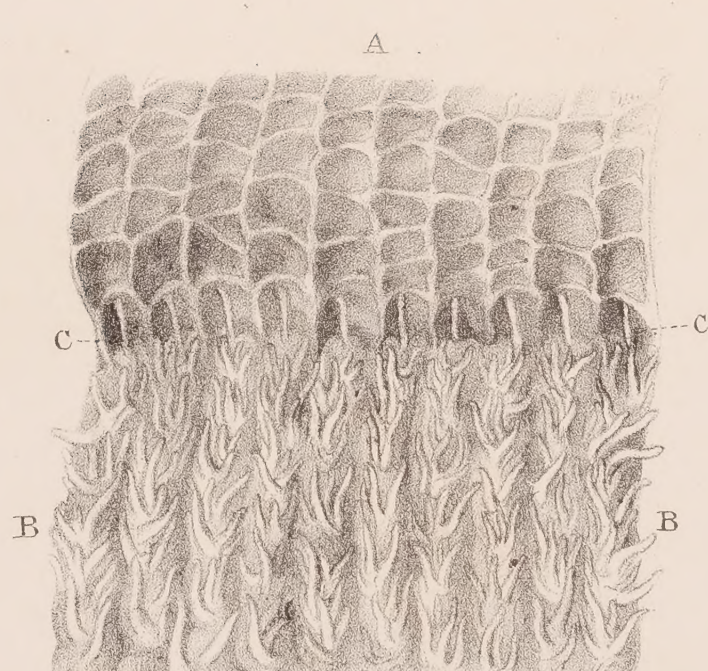


Fig 9.



different diameters are compared, it will be found that the antero-posterior exceeds the others by about a line. Anteriorly the globe of the eye is in relation with the conjunctiva (plate XXIX. fig. 6, Nos. 29, 30), which is reflected from the eye-lids upon it; posteriorly with the vessels and nerves (optic and ciliary) which enter it, and with a quantity of adipose substance (8, 8) in which it is in some measure embedded; round its circumference, with the six muscles inserted into it; superiorly and towards its outer side, with the lachrymal gland; and internally with the caruncula, tensor tarsi, and lachrymal sac.

The globe, or, as it is often called, the ball of the eye, is composed of membranes, placed one within the other, and of humours or fluids which they enclose; the former are not unfrequently called coats or tunics; but as none of them forms a complete investment, the term is not so applicable as that here adopted. The membranes are the conjunctiva, sclerotica, cornea, choroid, retina, and iris, the capsule of the crystalline lens, the hyaloid membrane, and that of the aqueous humour. The humours are the aqueous, vitreous, and the crystalline lens.

Dissection.—The eye should be examined whilst fresh, as the humours soon become putrid, and the membranes alter in consistence and other properties. The eyes of animals will answer sufficiently well in the first instance; but the relative proportions of the different parts must be studied in the human eye before operations can be attempted with safety. In order to obtain correct notions of the situation and relation of the various structures, it is necessary to make several sections of the globe. Thus a vertical section, by dividing it into two equal parts, will show the relative extent of the cornea and sclerotica, their mode of connexion, and the varying thickness of the latter in different parts. If it be suspended in water, the relation of the iris to the ciliary processes may be observed, and also the manner in which the latter are continuous with the choroid membrane. If a transverse section be carried through the coats, and the posterior half of them be removed, leaving the vitreous

PLATE XXXVII.

The organ of touch: the skin.

Fig. 1. A square of cuticle from the sole of the foot, highly magnified and seen upon its external surface.

A. Ridges which mark the rows of papillæ of the cutis. B. Interlinear furrows which correspond with the depressions between the papillæ of the cutis. C. The openings of the sudoriferous ducts on the surface of ridges: the appearance of transverse lines is produced by the depressions surrounding the openings of the sudoriferous ducts.

Fig. 2. A square of cuticle seen upon its internal surface.

A. The sulci which correspond with the ridges of the external surface of the cuticle. B. Ridges which correspond with the interlinear furrows of the external surface. C. Conical processes of the cuticle, into which the terminations of the sudoriferous ducts are received.

Fig. 3. A square of rete mucosum seen upon its external or epidermal surface.

A. Ridges corresponding in size and form with the papillæ of the cutis, and with the ridges of the cuticle. B. Furrows corresponding with the interlinear sulci of the cutis and of the cuticle. C. The transverse depressions mark the divisions between the secondary papillæ (interpapillary).

Fig. 4. A square of rete mucosum seen upon its internal or dermal surface.

A. The sulci for the rows of papillæ of the cutis, divided into small fossæ by transverse partitions. The small fossæ receive the secondary papillæ of the cutis. B. The longitudinal ridges correspond with the interlinear sulci between the rows of papillæ. C. Upon the summits of the ridges, at one angle of the square, are seen some of the dark vesicular corpuscles which give colour to the rete in the negro.

Fig. 5. A square of cutis seen upon its external surface.

A. The rows of papillæ separated by interlinear longitudinal furrows. The secondary papillæ, B, are divided from each other by transverse interpapillary depressions. Each of the secondary papillæ consists of a group of primary papillæ which are the true papillæ of the cutis. C. Some of the primary papillæ, longer than the rest, are seen projecting from the secondary papillæ. D. At one angle of the square the secondary papillæ are shown to be composed of a considerable number of primary papillæ.

Fig. 6. A square of cutis seen upon its under surface, showing the fibrous structure of the corium.

A, A. Cells between the fibrous bands of the corium, which receive the adipose lobules of the superficial fascia.

Fig. 7. A portion of cutis, from which the rete mucosum is partly turned back, in order to show the sudoriferous ducts passing between the two layers.

A. The rete mucosum. B, B. The cutis, with its rows of papillæ. C, C. The sudoriferous ducts, issuing from the transverse depressions between the secondary papillæ.

Fig. 8. A thumb, from which the cuticle has been removed, to show the arrangement of the papillæ upon its tactile surface.

Fig. 9. The thumb of the opposite hand, showing a different arrangement of the tactile papillæ.

humour resting on the anterior one, that disposition of the ciliary processes may be distinctly seen by which they are aggregated together so as to form a complete circle round the lens. When the ball of the eye is firmly compressed, the fluid within the lamellæ of the cornea is made to ooze out on its surface, and that membrane becomes opaque. The structure of the choroid membrane can be examined with most effect after the vessels have been filled with some fine injection, either from the internal carotid or ophthalmic artery. The size injection will answer sufficiently well for ordinary purposes.

In order to proceed with the examination, the fore part of the eye should be fixed: for this purpose a pin may be passed across the cornea, and the ends of it secured to a small plate of glass by a thread or cord. To keep the eye steady, it will be found useful to affix to the glass a lump of common wax, on the top of which the eye may be secured as above mentioned. Two incisions should then be carried over the ball of the eye, decussating with one another at the optic nerve, and thereby dividing the sclerotica into four elliptic segments. These are easily everted, and drawn outwards after a little cautious dissection, by which means the choroid is exposed.

In order to exhibit the retina, the eye should be fixed, and the same incisions made through the sclerotica. The apparatus should then be immersed in a bowl of water, in order that the humours may be supported when the exterior membranes are removed. But, in separating the choroid, two pairs of forceps should be used, one being employed to pinch up and hold a small portion of it, whilst it is torn with the other. This process may be continued until the whole of the vascular membrane is detached and everted, leaving the retina fully exposed.

The Conjunctiva.—The conjunctiva (*membrana conjunctiva, sive adnata*) is included by some writers amongst the accessory structures of the globe of the eye, and not amongst its proper membranes; as if it were a tegument or means of connexion with adjacent structures, and did not form part of the organ itself, considered as an optical instrument. Be this as it may, the membrane lines the free border and inner surface of the eye-lids, from which it is reflected upon the globe of the eye, so as to cover its anterior third. Along the borders of the lids it is continuous with the skin, and, by lining the *puncta lachrymalia*, forms a continuous surface with the mucous membrane of the lachrymal passages and nasal fossæ. It is red and vascular on the lids, but firm and pale on the sclerotica: it becomes thin and transparent on the cornea, so much so that some anatomists have doubted whether it extends over the entire of its surface. At present very few persons continue sceptical on this point; for even *à priori* we should infer its extension over the cornea, as every structure of the kind is known to require the protection of a tegumentary membrane. Moreover, in reptiles which cast their epidermis at stated times, the covering of the cornea comes away together with the rest; and finally, in the mus typhlus it is covered with hairs.

The Sclerotica.—The sclerotic (*σκληρός*, hard; *cornea opaca*: plate XXX. fig. 1, No. 1) belongs to the class of fibrous membranes; it is firm and resistant in its texture, and forms about four-fifths of the external investment of the eye, extending from the entrance of the optic nerve to the border of the cornea. Its external surface is convex, and in relation with the conjunctiva, with the tendinous expansions of the muscles, and the vessels and nerves of the orbit: the internal surface is concave, and in apposition with the choroid membrane, with which it is connected by vascular and nervous filaments, and by some delicate cellular tissue. Posteriorly it is pierced by a small circular aperture for the transmission of the optic nerve, situated a little to the inner side of the axis of the globe; anteriorly it is truncated, so as to leave an aperture about six lines in diameter, but somewhat greater in the transverse than in the vertical direction. The inner edge of this aperture is slightly bevelled off (plate XXX. fig. 5, No. 3), so as to allow the cornea to be inserted into it, somewhat as a watch-glass is into its case. The sclerotica being a fibrous membrane, its fibres interlace intimately, but do not assume any assignable direction. It is thicker posteriorly (fig. 5) than towards its anterior part; but in this latter situation it is strengthened by the tendinous expansions of the muscles, which some anatomists have considered as a distinct membrane, and denominated *tunica albuginea* (fig. 1, No. 8). At the back part of the globe it is about a line in thickness: at the insertion of the recti muscles it is scarcely half a line; but near the cornea it thickens somewhat. The aperture for the optic nerve is a little nearer to the nasal than to the temporal side of the globe, and is found to be divided by a number of septa, so as to constitute a *cribriform plate*, through which the pulp of the nerve may be made to ooze as if through minute pores. In the middle will be found one of these of larger size than the rest, which is named *porus opticus* (plate XXXI. fig. 5, No. 3). It gives passage to the centralis retinæ artery. At its exit from the skull, the nerve receives an investment from the dura mater, which accompanies it to the point at which it pierces the sclerotica, where it separates from the nerve, and becomes blended with the substance of the latter membrane.

The Cornea.—The cornea (plate XXX. fig. 1, No. 9; fig. 5, No. 4: *cornea pellucida*) occupies the anterior fifth of the globe of the eye, its transverse diameter being about seven lines, the vertical a little less. The anterior surface, which is convex and prominent, is in contact with the conjunctiva; the posterior is concave, and is lined by the membrane of the aqueous humour: its circumference, nearly circular in the human subject, is received within or overlaid by the anterior border of the sclerotica, with which it is so intimately united as not to be separable from it without long-continued maceration. Its degree of convexity varies in different individuals, and at different periods of life. It is composed of five or six concentric lamellæ, united by some connecting medium, probably a fine cellular tissue, the interstices of which contain an aqueous or serous fluid. It is thicker than the sclerotica, which may be readily seen by making a section of both; but it is by no means so dense; its layers will be found to slide almost upon one another when it is pressed between the fingers. The lamellated structure of the cornea is beautifully adapted to the functions of the eye. Were it fibrous, like the sclerotica, even though at the same time translucent, it would cause a dispersion of the rays of light, and thereby resolve them into their primitive or prismatic rays, which would necessarily produce a coloured and confused image. The effect may be readily exemplified by looking at a lighted taper through a feather: the flame will instantly appear surrounded by a halo of coloured images; and were the cornea made up of fibres woven ever so finely, the effect would be similar.

Ciliary ligament.—The ciliary ligament (plate XXX. fig. 2, No. 7; fig. 5, No. 6; plate XXXI. fig. 1, No. 3; *orbiculus ciliaris*, Haller) is a ring of light gray matter, about a line and a half in breadth, which is attached to the inner surface of the sclerotica, just at its junction with the cornea. Externally it is united, though slightly, with the sclerotica; posteriorly with the choroid membrane; and anteriorly with the iris, which may be said to be inserted into its substance. It adheres more firmly to the choroid than to the other textures; for though it is separated by a slight effort from the latter, it remains securely attached to the former. The ciliary arteries pass through it, and distribute some twigs to it, as do the ciliary nerves in their course to the iris. Its external surface or circumference presents a slight groove which runs around it, so that when in apposition with the sclerotica a minute canal is enclosed between them. Fontana appears to have been the first who noticed this circumstance; hence it has been named the canal of Fontana. Some anatomists have considered the ciliary ligament as a ganglion in which the ciliary nerves terminate, and from which branches proceed to the iris; but no instance can be adduced in which a nervous ganglion forms the medium of union and connexion between parts in the same way that this structure does, as we find it attached to the sclerotica, and giving attachment to the iris, choroid membrane, and ciliary processes.

The Choroid.—The choroid membrane (plate XXX. fig. 2, No. 2; fig. 3, No. 3; fig. 5, No. 5; *tunica vasculosa, choroidea*) lies between the sclerotica and the retina, extending from the entrance of the optic nerve as far as the ciliary ligament. In the greater part of its extent it is connected, though loosely, to the sclerotica by cellular tissue, and by the vessels which pass from without to reach it; but anteriorly the union is established through the medium of the ciliary ligament. The inner surface is in apposition with the retina, or rather with Jacob's membrane. Posteriorly the choroid presents a foramen, with a well-defined margin, for the transmission of the optic nerve: anteriorly, after becoming connected with the ciliary ligament, it is prolonged inwards towards the axis of the eye, and is drawn into a number of delicate folds, the aggregate of which forms a complete circle, resting, like a collar, round the border of the crystalline lens, and the anterior surface of the vitreous humour. In this manner are formed the ciliary processes, the aggregate of which has been variously named by different anatomists (*corpus ciliare, corona ciliaris*).

The choroid membrane is essentially vascular in its structure, being composed of minute arteries and veins, united by cellular tissue. When the sclerotica is removed so as fully to expose the choroid membrane, we find lying upon its surface, if the dissection has been carefully executed, the ciliary nerves (plate XXX. fig. 2, Nos. 6, 6; fig. 3, Nos. 5, 5) compressed and flat: their destination is the ciliary ligament and iris. Two long arteries will also be found (long ciliary arteries, fig. 2, No. 3; plate XXXI. fig. 1. Nos. 6, 6) passing horizontally forwards, maintaining little, if any, connexion with the choroid; for, after having pierced the sclerotica, they lie between the latter and the choroid, without giving branches to either; and when they reach the ciliary ligament, they turn inwards and divide into branches, which are exclusively distributed to the iris. These vessels are situated at opposite sides of the globe, nearly on a line with its axis; the external one, however, is a little above, the internal a little below it. But there is a set of vessels which are intimately connected with this membrane, being distributed to it exclusively, viz. the *short ciliary arteries*, which pierce the sclerotica nearer to

the optic nerve than the long ones, and soon divide into branches; these run at first parallel with one another, and mutually send twigs of communication, so that they all freely anastomose, particularly towards the anterior part of the choroid, where they form a circle, consisting of a most minute interlacement of vessels. The veins are readily distinguishable from the arteries by their greater size, as well as by their peculiar arrangement. They extend from before backwards in a radiated form, describing arches as they converge to the posterior part of the eye, and form by this union three or four small vessels, which pierce the sclerotica, and open into some of the secondary branches of the ophthalmic vein. As the veins of the choroid membrane are disposed in whirls, they are usually denominated *vasa vorticosa* (plate XXX.; fig. 2, Nos. 2, 2; fig. 3, Nos. 3, 6); they occupy for the most part the external, and the arteries the internal surface of the membrane. On this distribution of the vessels is founded the division of the choroid into two lamellæ, of which the internal is denominated *tunica Ruyschiana*, in compliment to Ruysch, who was the first that succeeded in demonstrating its structure by injection. The inner surface of the membrane, from its villous or fleecy appearance, has been called tapetum; when minutely injected, it is of a deep scarlet colour. It appears to secrete the colouring matter (*pigmentum nigrum*), which is a viscid and apparently mucous secretion, deposited upon the internal surface of the membrane. Its quantity varies in different parts, being more abundant anteriorly and in the interstices of the ciliary processes.

PLATE XXXVIII.

The anatomy of the skin.

Fig. 1. Capillary vessels of the skin, considerably magnified, from an injected preparation.

A, A. Arterial branches. B, B. Capillaries. C. A venous trunk collecting the blood from the capillaries.

Fig. 2. Plexus of lymphatic vessels in the skin, considerably magnified, from an injected preparation.

Fig. 3. A thin section of the skin from the palm of the hand, highly magnified.

A, A. The cuticle, showing its laminated structure and the oblique direction of the laminae. B, B. The imbricated arrangement of the surface of the cuticle, giving rise to the appearance of ridges and furrows. C, C. The rete mucosum:—this was seen beneath the microscope, with a transmitted light, as a narrow translucent line; its thickness in relation to the cuticle and papillary layer is carefully preserved. D, D. The papillary layer of the cutis, in which are represented five secondary or larger papillæ; each secondary papilla being seen to be composed of a group of primary papillæ. E, E. The upper part of the corium, darker in colour than the rest of the layers, from its compactness of structure, which prevents the passage of transmitted light, and also from its greater vascularity. F, F. The lower part of the corium, less compact and vascular than its upper surface. G, G. Adipose vesicles. H, H. Sudoriferous follicles, from which the sudoriferous ducts are seen issuing, and traversing the corium, papillary layer, rete mucosum, and cuticle, to reach the pores upon the surface of the skin. In the cuticle the sudoriferous ducts are beautifully spiral; in the papillary layer they are slightly curved; and in the corium they generally lose the regular spiral arrangement and become serpentine, or retain one or two turns only. I, I. Some sudoriferous follicles and ducts, seen dimly in the deeper parts of the section.

Fig. 4. A thin section of the scalp, highly magnified; showing the mode of growth of the hairs, and the form and arrangement of the sebaceous follicles.

A, A. The cuticle. B, B. The thin layer of rete mucosum. C, C. The papillary layer. D, D. The corium. E, E. Adipose vesicles. F, F. The secreting follicle of the hair. G, G. Sebaceous follicles, terminating in ducts which open into the follicle of the hair. Sometimes a sebaceous follicle is situated at each side of the hair, as at H. I. The bulb of the hair. K. The irregular branch-like processes developed from the cylinder of the hair. L, L. Sudoriferous follicles, from which ducts are seen ascending to the surface of the cuticle.

Fig. 5. A thin section of skin from the extremity of the nose, showing the sebaceous follicles.

A, A. The sebaceous follicles of irregular form, consisting apparently of the convolutions of a single tube. B, B. The small down-like hairs, provided with a secreting follicle, but having no connexion with the sebaceous follicles. C, C. The openings of the ducts of the follicles upon the surface of the skin.

Fig. 6. Section of a thumb, showing the relation of the nail to the soft parts.

A. The last phalanx. B. The cuticle reflected upon the root of the nail. C. The nail. D. The cuticle of the point of the thumb continuous with the inner surface of the nail. E. One of the longitudinal and plicated papillæ, which secretes the nail.

Fig. 7. The upper surface of the thumb, from which the cuticle and nail have been removed.

A, A. Two flaps of skin turned aside from over the insertion of the root of the nail. B. The smooth surface of the secreting structure of the nail which corresponds with the lunula. C. The longitudinal and plicated papillæ which secrete the laminae of the nail.

Fig. 8. The under or dermal surface of the nail.

A. The thin edge by which the nail is inserted beneath the integument of the finger. B. The lunula. C. The laminae of the nail, secreted by the plicated papillæ.

Fig. 9. A magnified representation of the arrangement of the secreting capillaries of one of the plicated papillæ.

Fig 1

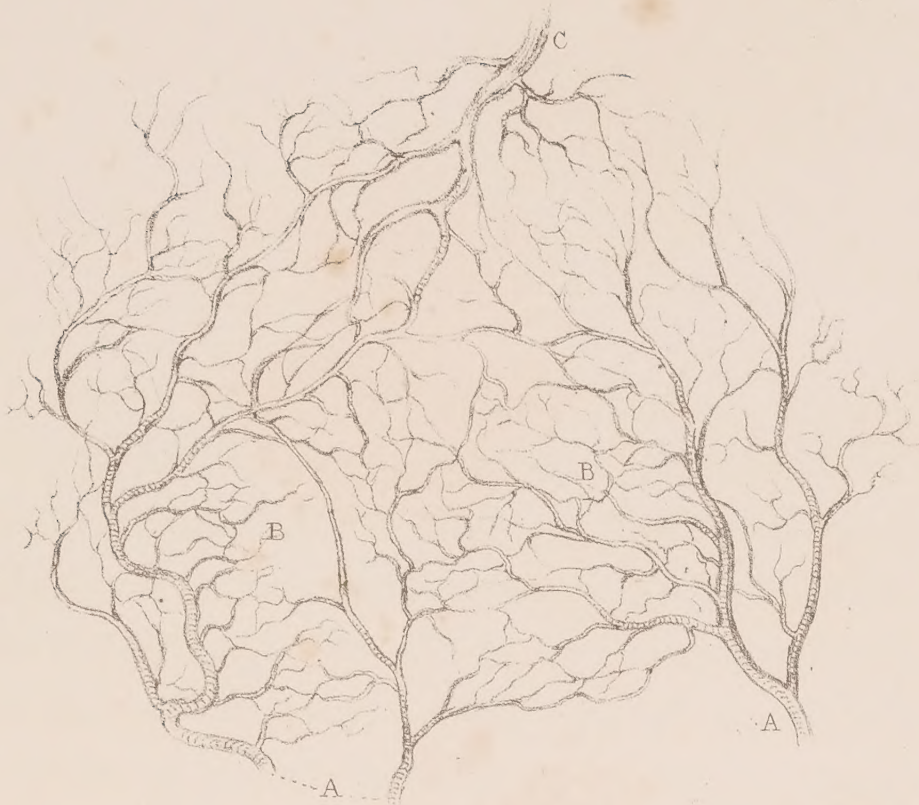


Plate 38.

Fig 2

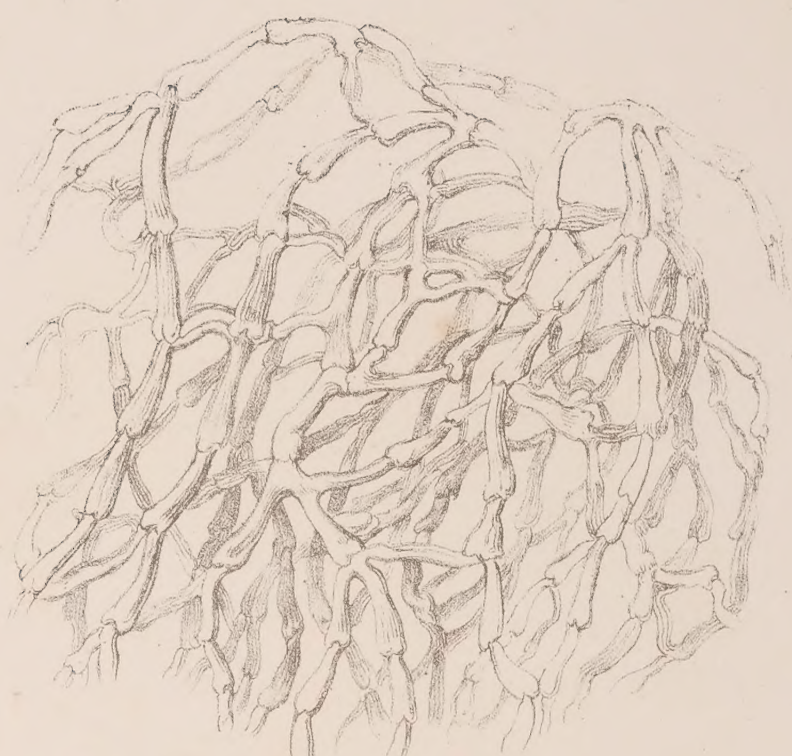


Fig 3.

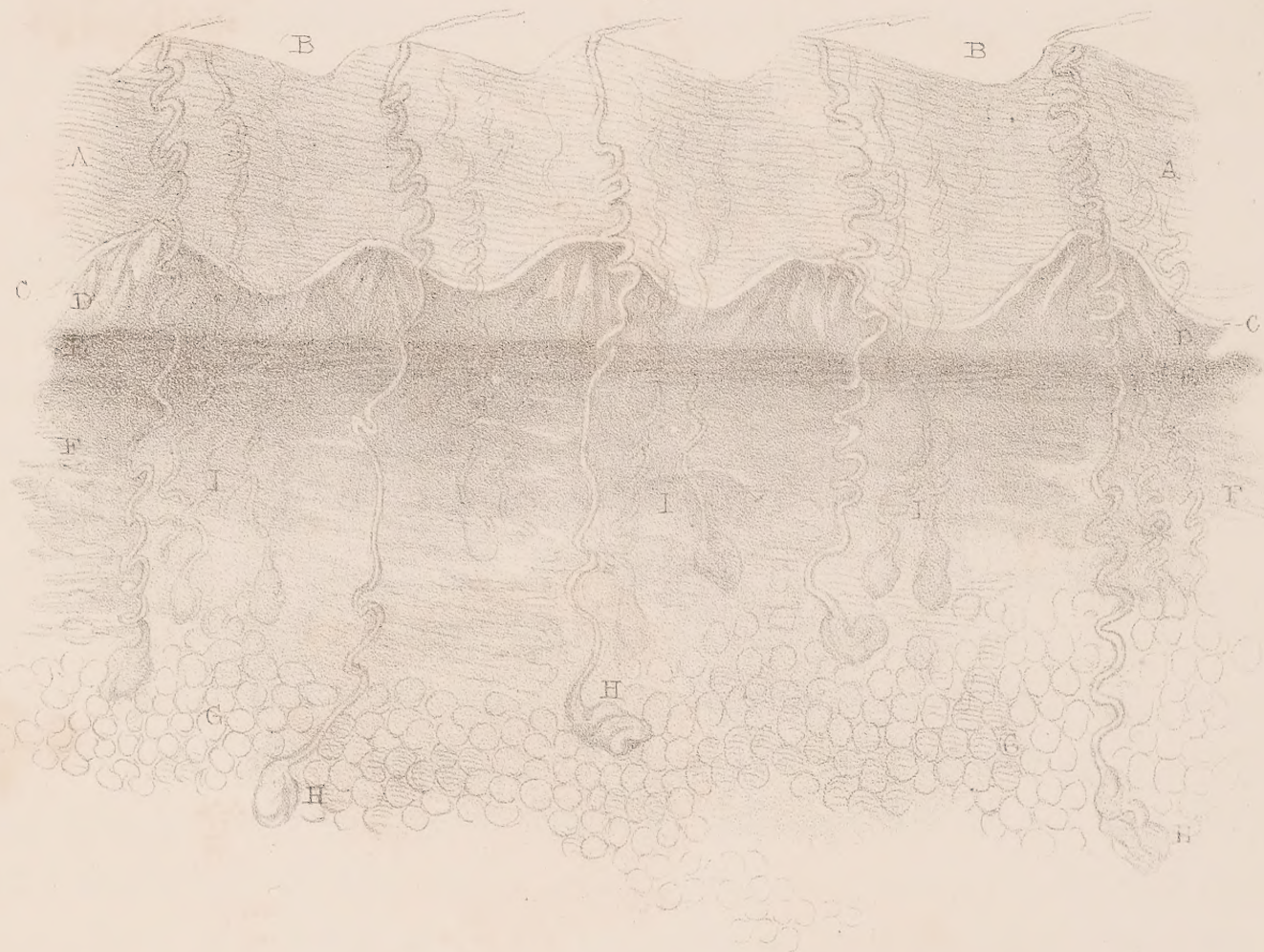


Fig 6.

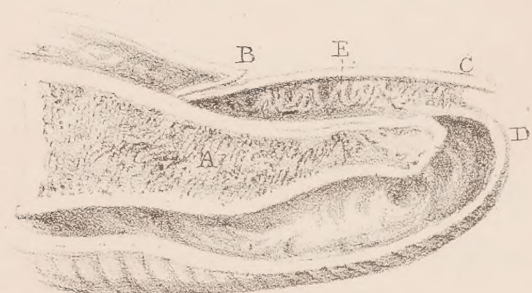


Fig 7.

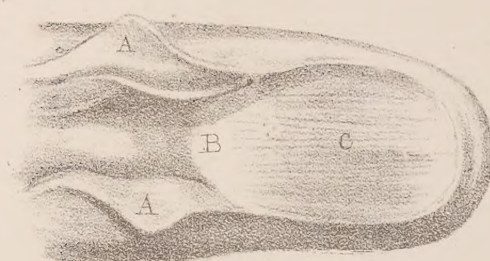


Fig 4.



Fig 8.

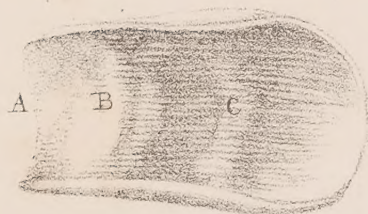


Fig 9



Fig 5.



Wm. Fairland, Litho.

W. T. E. Wilson, direct.

Drawn from Nature by W. Bagg.
London, Taylor & Walton, Upper Gower Street.
Printed by Fairland.

Ciliary processes.—The ciliary processes, formed, as has been above stated, of the anterior margin of the choroid, are from sixty to eighty in number (plate XXXI. fig. 2, No. 2; fig. 3, No. 3: plate XXX. fig. 5, No. 8). The form of each lamella, or process, is triangular; one side looks forward to the iris, the other backward to the vitreous humour, with which it is in contact; the third or internal one, the shortest, is free. The processes are alternately long and short, and in their arrangement resemble the plicæ observable on the under surface of a mushroom. The intervals between the processes are filled by a pigment similar to the pigmentum nigrum in every particular, which leaves on the surface of the lens and of the vitreous humour a number of dark striated lines, corresponding not with the processes, but with the intervals between them. When removing the ciliary processes, it will be observed that they are not merely in contact with the anterior part of the hyaloid membrane; minute plicæ of the latter project into the interstices between the processes, and seem to be connected with them. The name ciliary body (*corpus ciliare*) is usually given to the aggregate of the ciliary processes.

Retina.—The retina (plate XXX. fig. 4, No. 1; fig. 5, No. 9: *tunica nervea*) is placed between the choroid membrane and the vitreous humour, with which it is merely in apposition. It extends from the bottom of the eye, where it is continuous with the optic nerve, forwards as far as the commencement of the ciliary processes, where it appears to terminate by a defined and rather prominent line. Its structure is soft and pulpy; in the living subject it is transparent, and so continues for some hours after death, but then becomes of a pale white colour. When the ophthalmic artery has been minutely injected, the membrane can be shown to consist of two lamellæ, of which the internal is vascular, and presents several small vessels, which arise from the *centralis retinae* artery; the external lamella appears to consist of white nervous matter. If the eye be macerated for some days in water, the latter part of the retina can be washed away, leaving the vascular lamella in its natural position. About two lines outside the entrance of the optic nerve may be observed in the retina a small hole and a yellow spot, first described by Sœmmering, and named by him, the one *foramen centrale*, the other *limbus luteus* (plate XXX. fig. 4, No. 2: plate XXXI. fig. 4, No. 4; fig. 5, No. 1). The yellow spot appears to coincide with the axis of vision; the appearance which has been called a foramen is owing to a transparent point in the retina, and not to a perforation of its substance; the outer or medullary layer is merely deficient.

“Exclusively of the two layers here noticed, the retina is found to be covered on its external surface by a delicate transparent membrane, united to it by cellular substance and vessels. If the sclerotica be removed, and the choroid membrane carefully torn and averted, small portions of the structure here alluded to can be detached, or a globule of air, or even of quicksilver, may be insinuated beneath it, by which means it is raised, and can be seen distinctly if held towards the light.”* This is now known as *Jacob's membrane*. It cannot be said to be a part of the retina, or to consist of its medullary lamella detached by the process resorted to in the dissection of the organ; for the yellow spot of Sœmmering is not distinctly seen until Jacob's membrane is removed; and when this has been effected, we can still show the retina to consist of its two lamellæ.

The Iris.—The iris (plate XXX. fig. 2, No. 3; fig. 5, No. 15: plate XXXI. fig. 1, No. 2), which presents the coloured circle seen through the transparent cornea, resembles a partition placed vertically so as to divide, but very unequally, the interval between the cornea and the lens into two parts. This interval is filled by the aqueous humour, so that the iris moves freely in the fluid. The space between it and the cornea, which is much the larger, is called the *anterior chamber* (plate XXX. fig. 5, No. 13); that behind it is the *posterior chamber* (17): both communicate through the pupil. The iris presents two flat surfaces and two circumferences; on the anterior surface, which is differently coloured in different individuals, may be observed two concentric rings, of which the external (plate XXXI. fig. 6, No. 3: *annulus major*) is broader than the internal, but not so deeply coloured: it is marked by several striated lines, which pass from the great circumference inwards to the pupil, where they seem to bifurcate. The inner ring (fig. 6, No. 2: *annulus minor*) is more deeply coloured, and surrounds the pupil. The posterior surface contiguous to the ciliary processes is covered by a dark pigment similar to that of the choroid; it is usually called *uvea* (fig. 3, No. 2). When this is washed off, a number of fine lines, or fibres, may be observed, with the assistance of a magnifying power, converging from the greater circumference to the pupil; these are distinct from one another in the former situation, but in the latter are blended so as to form a membranous zone.

The great circumference of the iris corresponds with the ciliary ligament (plate XXXI. fig. 1,

* An Account of a Membrane now first described, by Arthur Jacob, M.D.—*Phil. Trans.* 1819.

Nos. 3, 3), into which it may be said to be inserted: the smaller forms the border of the aperture called the *pupil* (fig. 1, No. 1: *pupilla*). The pupillary aperture is closed in the foetus, up to the seventh month, by a delicate transparent membrane, called, from this circumstance, *membrana pupillaris* (plate XXXI. figs. 11, 12). If examined after the vessels of the eye have been injected, it will be found distinct from the iris, and appearing as if inserted into its margin, so as to cut off all communication between the two chambers. It becomes reticulated a little after the time referred to, then a few fragments of it only remain, and finally it disappears before birth. According to M. Jules Cloquet's account, it is a sort of mediastinum formed by the contiguous sides of two small culs-de-sac, one of which is the membrane of the aqueous humour continued across upon the front of the iris, the other the lining membrane of the posterior chamber, both being in apposition at the pupil.

The iris is abundantly supplied with nerves from the ciliary nerves: it receives the two long ciliary arteries which pass along between the choroid and sclerotica, and the smaller, or anterior ones, which pierce the ciliary ligament from without. These vessels approach the iris from four opposite directions, and at its greatest circumference freely anastomose, so as to form the larger vascular circle of the iris. From this circle branches pass inwards, converging, and form at a little distance from the pupil another circle, by a second anastomosis. Finally, from this inner circle minute filaments pass inwards, and seem to terminate at the pupillary margin of the iris. The veins, in general, take the same course as the arteries, but the greater number open into the vasa vorticosa. The ciliary nerves, after having passed through the ciliary ligament, incline inwards upon the anterior surface of the iris, where they divide into fine filaments, which soon elude our research, even with the aid of a microscope.

The Humours of the Eye.—The *aqueous* humour is a thin, pellucid fluid, which fills up the two chambers of the eye, occupying the space between the cornea and crystalline lens. Its specific gravity and chemical composition differ little, if at all, from those of the vitreous humour; it is moreover enclosed in a thin transparent membrane, which secretes it in the first instance, and reproduces it when evacuated by accident, or during operations. This membrane (plate XXX. fig. 5, No. 14), usually called the *capsule* of the aqueous humour, lines the cornea and the anterior surface of the iris, but does not seem to extend into the posterior chamber.

Crystalline lens.—The crystalline lens (plate XXX. fig. 4, No. 7; fig. 5, No. 18: plate XXXI. fig. 2, No. 3; figs. 8, 9, 10) is situated at the union of the anterior third with the two posterior thirds of the eye, lying behind the iris, surrounded by the ciliary processes, and embedded in the vitreous humour; it is perfectly transparent, soft in the greater part of its extent, but of high refracting power. The lens is doubly convex; but the posterior segment which is received into the vitreous humour is more convex than the anterior; the convexity of both is greater in infancy than in adult age. The greatest thickness of the lens is about two lines and a half; its circumference measures from twelve to fourteen. It consists externally of a soft and homogeneous substance, presenting no trace of organisation; but the central part, more dense and firm, is made up of concentric lamellæ.

The lens is enclosed in a delicate capsule, which invests it all round, but without any distinguishable adherence to it, and is thicker and firmer on the anterior than on the posterior surface. If a puncture be made in the membrane, a small quantity of a pellucid fluid, which is termed *liquor Morgagni*, issues from the incision. When macerated in a dilute acid, or suddenly plunged into boiling water, the capsule becomes opaque and corrugated, presenting a pale, milky appearance. The lens, having its posterior segment embedded in vitreous humour, is retained in its situation so firmly that it requires some effort to detach it. This is accounted for by supposing that the lens and its capsule are both enclosed within a duplicature of the hyaloid membrane; or rather, after investing the vitreous humour, this membrane, as it approaches the circumference of the lens, divides into two lamellæ, of which one passes before, the other behind that body. By this arrangement an interstice of a triangular form is left, the apex of which is at the point of division of the membrane, the base at the margin of the lens; and as this is continued all round, it forms a canal, named the *canal of Petit* (plate XXX. fig. 5, No. 20). When distended with air, which can be easily done by puncturing it and inserting the point of a blowpipe, the canal presents the appearance of a chain of minute vesicles disposed round the lens, communicating freely, inasmuch as the air passes from one to the other. This is attributable to the existence of filaments or bands connecting the lamella which passes before with that passing behind the lens, so as to stricture the intervening space—the canal, from point to point. The formation of the canal, and the connexion of the lens with the vitreous humour, has been accounted for in a different way from that here indicated. The hyaloid membrane, instead of dividing into lamellæ which encase the lens, may be said to pass altogether behind it, simply enclosing

the vitreous humour, as in other parts of its extent. The zonula of Zinn (plate XXX. fig. 4, No. 5) is considered a distinct structure, being firmer than the hyaloid upon which it rests. It is a flat, thin, membranous lamella, whose inner circumference surrounds the lens, the outer being connected organically with the anterior edge of the retina; its anterior surface presenting a number of dark lines, being so many markings left by the pigment of the ciliary processes which rest upon it, as well as delicate folds which are received into the interstices between these processes, and form a connexion with them. This membrane, supposing it to be a distinct structure from the hyaloid, may be said to retain the lens in its situation, and to form the anterior wall of the canal of Petit.

The capsule of the lens receives a minute branch from the arteria centralis retinae, which ramifies on its posterior segment, but none of its branches have been found to extend to the substance of the lens. The lens has been supposed to be muscular in its structure, and thereby to possess the power of altering its form, so as to adapt the eye to the different distances within which distinct vision obtains. This opinion was first promulgated by Dr. Pemberton,* in a thesis written at Leyden. Dr. Young† brought it forward again some years ago, and several physiologists have assented to it. Chemical analysis, however, has long since shown that the lens consists of pure albumen, some gelatine, and water, without the slightest admixture of fibrine, the essential constituent of muscle. Moreover, were it muscular, it must consist of fibres of some sort; and were these ever so minute or so fine, the density of the points corresponding with the fibres must be greater than that of the intervals, for intervals there must be where there are striæ, or lines; and to suppose a muscle without lines and intervals, is to suppose what has not yet been seen in nature. Were such a structure as this made a medium for the transmission of light, the rays must be dispersed and resolved into their primitive or prismatic rays, producing of necessity a coloration of the image and indistinctness of vision. The remarks and the experiment above cited, to show that the cornea must be homogeneous, apply with equal force to the structure of the lens.

Vitreous humour. — The *vitreous humour* (plate XXX. fig. 5, No. 21; humor vitreus, corpus vitreum) fills up the posterior two-thirds of the globe of the eye. It consists of a thin transparent fluid enclosed in a fine membrane (*hyaloid membrane*, 11); this not only invests it externally, but forms a number of processes, projecting inwards, and dividing it into detached masses, which may thus be said to be lodged within the areolar intervals of the membrane. Some anatomists suppose also that it forms a tubular fold (22) which reaches from behind forward, enclosing the branch of the centralis retinae artery which passes to the lens. This structure, though thin and transparent, is yet firm, particularly at the fore part. The term *corpus vitreum* is sometimes applied to the fluid and the capsule taken together. Anteriorly, at the central part, is a slight depression which lodges the posterior segment of the crystalline lens, and farther out, where it corresponds with the ciliary processes, is an annulus, or disk, called the zonula of Zinn: we here observe a number of dark lines converging like radii, and disposed in the form of a disk round the lens. But, besides the dark lines, which are merely streaks left by the pigment which had exuded from the intervals between the ciliary processes, there are also some delicate plicæ in the membrane itself; these project so as to be received between the contiguous ciliary processes, and form a connexion with them. This part of the membrane appears to differ somewhat from the rest of it, which induced Zinn to consider it a distinct structure; hence he called it “membranula,” and the coloured disk and plicæ “zonula coronæ ciliaris.”

When the eye is examined as an optical instrument, with a view to determine the influence which it can exert upon the rays of light, it becomes necessary to examine the dimensions, form, densities, &c. of its different components. The humours being so many media of transmission, their effects can be calculated only by knowing their density, refracting and dispersive powers. And as the membranes serve to enclose the area within which all the changes take place, the form of the space, its axis, and diameters, require to be subjected to accurate measurement. But these topics do not properly come within the scope of an elementary work on anatomy.

THE EAR.

The organ of hearing is divisible into three parts, viz. the auricula, or external ear, which receives the impressions of sound; the tympanum, a middle chamber, which transmits them; and the labyrinth, or internal ear, which contains the sentient apparatus.

The *auricula* (including under that term the pinna, or flat part; and the meatus auditorius, or the tube which leads from it to the tympanum,) is placed at the side of the head, behind the jaw, and before the mastoid process.

* Haller, Disputationes Anatomicae, tom. vii.

† Phil. Trans. 1809.

The *pinna*, or flat part, (plate XXXII.) is of an irregularly oval form, its superior extremity being broad, the inferior somewhat elongated and narrow. Its surfaces are marked by some prominent lines and depressions which have received particular names. The semi-circular prominent line, (plate XXXII; fig. 2, Nos. 2, 2) which runs round the border of the pinna, is called the *helix*; it may be said to commence at the centre of the concha, above the meatus externus, and to terminate at the lobule, after having formed the margin of the ear. Within this, and, as it were, enclosed by it, is another curved prominence, the *anti-helix* (4), which begins above the concha by two slightly elevated lines (5, 5), that converge and unite to form the line that bounds the concha, and finally terminates at the anti-tragus. The *tragus* (8) is a small triangular prominence, that projects over the anterior and external part of the auditory tube; its margin is covered with hairs; and opposed to it stands another, which is smaller, and called, from its position, *anti-tragus* (9); it forms the termination of the anti-helix.

These parts owe their form and consistence to a firm lamella of fibro-cartilage, which constitutes their basis, and upon which the integument is reflected, giving it its exterior investment. The inferior and elongated portion of the pinna is called the lobule (12, *lobulus*). It is soft and pendulous, and differs in structure from all the rest, as it contains no cartilage, being composed merely of a thick lamella of condensed cellular and adipose tissue, subjacent to the common integument. Between the prominences above noticed three depressions are observable, differing very much in form and size. The helix and anti-helix are separated by a narrow groove (7) sometimes called *fossa innominata*. The shallow depression (6) between the two ridges presented by the anti-helix superiorly, is termed *fossa navicularis*; whilst the deep excavation (10), bounded by the anti-helix, and leading into the meatus auditorius, is called *concha*. This is a deep depression, bounded above and behind by a crescentic prominent margin formed by the anti-helix; it is surmounted in front by the tragus, at the opposite point by the anti-tragus, and divided unequally by the ascending curve of the helix, which, as we have said, may be considered to arise out of it. The inferior, or larger fossa of the concha, leads forwards and inwards to the meatus externus. The concha is necessarily prominent and convex posteriorly, and to this part the term *dorsum* is sometimes applied. When the integuments are removed, it will be found that the cartilage is incomplete at some points, presenting fissures which are filled up by cellular or fibrous membrane. Between the tragus and the commencement of the helix, there is a large interval of this sort (fig. 4, No. 14), and another between the inferior termination of the helix and anti-helix, where they surmount the lobule.

The pinna is retained in its situation not only by the integument and by its connexion with the meatus, but also by fibrous bands, which some have described as ligaments: one of these connects the tragus with the root of the zygoma, another passes from the convexity of the concha to the mastoid process, a third extends from the temporal aponeurosis to the upper part of the concha.

We have already described the muscles of the external ear. These may be said to act on the pinna as a whole; there are others, however, which are calculated to move the different parts of which it is composed, but are so rudimentary in man as scarcely to deserve notice. It is usual to enumerate five of these, their names being taken from the parts of the pinna to which they are attached. As to their action, we may omit all mention of it in the human subject.

Musculus major heliciis arises just above the tragus, runs upwards upon the helix, and terminates where it is about to curve backwards. *m. Minor heliciis* commences in the concha close to the commencement of the helix, inclines upwards and forwards, and is lost upon the rim of the helix. *m. Anti-tragicus* commences at the posterior surface of the anti-tragus, upon which it passes upwards and outwards to terminate upon the helix, crossing the fissure between it and the anti-tragus. *m. Tragicus* consists of some fibres which are placed upon the tragus, extended from its base to its apex. *m. Transversus auriculæ* stretches from the convexity of the concha to that of the fossa innominata. To these Mr. Tod,* in his publication on the ear, has added two muscles not hitherto named: *musculus obliquus auris*, which extends from the dorsum of the concha to that of the scapha; and *m. contractor meatûs* (trago-helicus), which ascends from the tragus obliquely to the anterior extremity of the helix.

The *auditory tube* (plate XXXIII. fig. 1, B; meatus auditorius externus) leads from the concha towards the cavity of the tympanum, from which it is separated by the membrana tympani: its direction is obliquely forwards and inwards, with a slight inclination at first upwards and then downwards, so that it describes a curve, the concavity of which looks downwards and a little forwards.

* The Anatomy and Physiology of the Organ of Hearing, by David Tod.

The length of the tube is about ten or eleven lines, but its lower surface measures more than the upper, in consequence of the obliquity of the membrana tympani; its form is oval, for when a section is made of the tube, its greater diameter will be that from above downwards. Its capacity is not equal throughout its entire extent; it is wider externally where it passes off from the concha than internally at its termination, and about the middle point between these it is a little narrower than elsewhere. The meatus is made up partly of cartilage, and partly of a ring of bone, about six lines long, and placed between the mastoid process and the root of the zygoma, and above the glenoid fossa. In the adult it is identified with the temporal bone; in the foetus it represents a thin osseous ring, connected with it chiefly by membrane, and somewhat by bone at its upper and outer part. The cartilaginous part (plate XXXII. fig. 5, No. 12) is continuous externally with the concha, from which it is prolonged inwards, to be attached by some short irregular fibres to the rough margin of the osseous ring, with which it thus forms a continuous tube. The cartilaginous and osseous structure occupy each about half the length of the meatus. But the cartilage does not complete the tube in its external half; it may be said to commence from the base of the tragus and the inferior and back part of the concha; proceeding inwards, it becomes curved upon itself so as to form the under and anterior portion of the tube, but is deficient at its superior and external part, where its place is supplied by dense fibrous membrane. The meatus is lined by a prolongation of the external tegument, which resembles a blind sac, like the finger of a glove, its termination being reflected upon the outer surface of the membrana tympani. The tegument gradually becomes thinner as it recedes from the concha; and when its cuticle is removed, it presents a number of pores or apertures, being the outlets of the glands which secrete the cerumen of the ear.

Membrana Tympani—the Tympanum.—The membrana tympani (plate XXXIII. fig. 1, No. 13; plate XXXIV. fig. 1, No. 15) forms the inner boundary of the meatus externus, and separates it from the cavity of the tympanum. The membrane is inserted into the inner margin of the osseous tube, and is placed so obliquely in its situation that its external surface looks outwards, downwards, and forwards; it is, moreover, concave, whilst the internal surface, which looks to the cavity of the tympanum, is convex. The membrane consists of three lamellæ, one being proper to itself, and of a fibrous structure, the others being tegumentary membranes, reflected upon it, and derived, the one from the skin, which is prolonged in the form of a cul-de-sac into the auditory tube, whilst the other is continuous with the mucous lining of the tympanum.

Sir Everard Home advocated the opinion, that the proper or middle membrane of the membrana tympani consisted of muscular fibres, and supported his views by appealing to his dissection of the part in the elephant. No one is disposed to deny its being fibrous; but as to its being muscular, that forms an additional matter of inquiry. The fibres appear to converge from the circumference of the ring of bone towards the central line, and are connected intimately with, if not actually inserted into, the outer surface and apex of the long handle of the malleus, also into its short process. From this arrangement it results, that all that part which corresponds with the former is concave outwards; but the remainder, being about an eighth of the whole, is slightly convex. The form of the membrane is an irregular oval in the foetus, but in the adult it is nearly circular.

The *cavity of the tympanum* (plate XXXIII. fig. 1, C) is narrow and irregular in its form, and so placed in the pars petrosa that the meatus externus lies to its outside, the labyrinth to the inner side, while the mastoid cells open into it posteriorly, and the Eustachian tube anteriorly. Its external wall is formed almost exclusively by the membrana tympani; the internal is composed of an irregular bony lamella, in which we observe the following elevations, openings, &c. The *promontory* (fig. 6, No. 5; promontorium), a rounded bony eminence, corresponds with the middle of the extent of the tympanum, if taken from before backwards. Above the promontory is situated an aperture, the *fenestra ovalis* (fig. 6, No. 4), which leads into the vestibule, but is closed by a thin membrane, which prevents any direct communication between the cavities. The greater diameter of the fenestra is directed obliquely backwards and a little downwards. Beneath the promontory, and almost concealed by it, is another aperture, called *fenestra rotunda* (6), though its form rather approaches that of a triangle: it corresponds with that part of the cochlea called *scala tympani*, and is also closed by a membrane.

When we examine the circumference of the tympanum, we find, at a point posterior and external to the promontory, and opposite to the inferior extremity of the fenestra ovalis, a small triangular bony process called the *pyramid* (fig. 6, No. 7), the summit of which presents a minute opening, leading to a tube (*fistula*) in its interior, that lodges the stapedius muscle. Between the pyramid, the promontory, and fenestra ovalis, is a depression called sinus or sulcus tympani. Behind and at the

root of the pyramid is a minute foramen (8, *apertura chordæ*), which gives passage to the vidian nerve as it enters the tympanum from the aqueduct of Fallopius, and assumes the name of the chorda tympani. This bony canal is sometimes called *iter ab aquæductu ad tympanum*. A little above this orifice is a convex ridge (2), which runs upwards and forwards over the fenestra ovalis; it marks the course of the aqueduct of Fallopius. At the posterior and superior part of the cavity is situated an aperture, leading into the interior of the mastoid process (1), which is hollowed into cells partially separated by bony septa, and lined by mucous membrane prolonged from the tympanum; so that the mastoid cells may be considered as diverticula or prolongations from the latter cavity. In the anterior part of the floor of the cavity is the glenoid fissure, which transmits the chorda tympani nerve, the laxator tympani muscle, and lodges the processus gracilis of the malleus. Finally, at the inner and anterior part of the cavity are two orifices, with a small bony lamella (*processus cochleariformis*) interposed between them, which separates two canals into which these orifices lead: the superior or smaller one (fig. 6, No. 10) transmits the tensor tympani muscle, the other (12) forms part of the Eustachian tube.

Eustachian Tube.—The Eustachian tube (plate XXXIII. fig. 1, No. 21), is from an inch and a half to two inches long, its posterior and external part being an osseous canal, the remainder composed of fibro-cartilage and fibrous membrane; its direction, as it leads from the anterior and inner part of the tympanum to the fauces, being forwards, inwards, and a little downwards. The osseous part narrows somewhat as it proceeds forwards; the cartilaginous, on the contrary, widens, so that the tube is constricted towards the middle, but is expanded at its extremities, particularly at the guttural one, which will be found thickened and trumpet-shaped. The osseous part of the tube occupies about one third of its extent, and is placed beneath the canal for the tensor tympani muscle, from which, and from the carotid canal, it is separated by a thin osseous lamella. The cartilage does not surround the tube; it forms the inner and upper side of it, and also part of the external, the remainder being made up of fibrous membrane. The tube thus formed is lined by mucous membrane prolonged into it from the pharynx, which thus becomes continuous with the lining of the tympanum.

Bones of the Ear.—The bones of the ear (*ossicula auditûs*) form a chain consisting of three minute pieces, extended across the cavity from the membrana tympani to the fenestra ovalis, each being articulated with the other, so that the whole chain is moveable. A fourth is very generally enumerated—the os orbiculare; but Sœmmering and some other anatomists consider it merely as a process of the incus. The bones are arranged in such a way that the malleus or external one is connected with the membrana tympani, whilst the stapes, which is placed internally, rests on the membrane of the fenestra ovalis, the incus being situated between both and articulated with them.

The *malleus* (plate XXXIII. fig. 2, A, B), so called from some resemblance to a hammer, is the first or most external of the series, and presents a head, neck, and processes. The head, or superior part (1), is convex and round in the greater part of its extent, but presents at its inner and posterior aspect two slightly irregular surfaces, covered with cartilage, by which it articulates with the incus. The neck (2) is the short constricted part that intervenes between the head and the processes. The handle (3, *manubrium*) is an elongated process, which, when the bone is *in situ*, inclines downwards and forwards, and terminates in a small rounded process, corresponding with the most prominent part of the membrana tympani, with which it is intimately connected. The short process (4) inclines outwards at right angles, from the upper extremity of the handle, and lies in contact with the membrana tympani. The long process (5, *gracilis, anterior*) extends from the cervix obliquely downwards and forwards; it is very thin, and ends in a point which passes into the glenoidal fissure.

The *incus* (fig. 2, C, D), is so called from some resemblance in shape to that of an anvil; it has been compared also to a molar tooth; but its similitude to either is very remote. This bone lies a little behind and to the inside of the malleus; it may be considered as divisible into a body and two processes. The body (2), compressed and somewhat square in its form, is directed forwards and upwards; and if its anterior border be viewed in profile, it will be found to present two surfaces, which meet at an angle, and are intended to articulate with the head of the malleus. One of the processes (3, *processus brevis*) shorter than the other, and also superior and posterior to it, is directed obliquely backwards towards the mastoid cells, where it terminates in a free point; the other process (4, *processus longus*) is longer but thinner than the preceding; it is directed forwards and downwards in the greater part of its extent, but near its termination it suddenly turns inwards, and ends in a small rounded process or nodule (C, No. 5; D, No. 1), which articulates with the head of the stapes. This is the part which is considered by some to be a distinct bone, and as such is named *os orbiculare*.

The *stapes* (fig. 2, E), or stirrup-bone, is placed horizontally, with its base resting against the fenestra ovalis, and its head articulated with the round nodule at the extremity of the long process of the incus, which it receives in a small shallow cavity. The base of the bone is of the same form as the fenestra ovalis, on which it rests, its upper border being convex, and the lower straight. The anterior process is shorter and straighter than the posterior, and both are slightly grooved along their inner borders, where they give attachment to a membrane that fills the interval between them. The two processes converge and meet at a narrowed part, which is sometimes called the neck, and which is surmounted by a small tubercle or head. The head inclines outwards, and articulates, as above stated, with the incus.

Internal muscles of the Ear.—These muscles,* like the bones above described, are the smallest in the body : only four are usually enumerated, of which three are attached to the malleus. *m. Internus mallei* (tensor tympani) arises from the upper surface of the cartilage of the Eustachian tube, and also from the contiguous border of the pars petrosa ; thence it inclines outwards and backwards in the osseous canal that runs parallel with the Eustachian tube, and becomes tendinous on entering the tympanum, where it is inserted into the short process of the malleus. *m. Externus mallei* (laxator tympani major) arises from the spinous process of the sphenoid bone, and, soon becoming tendinous, passes through the glenoid fissure to be inserted into the processus gracilis of the malleus. *m. Laxator tympani minor* is very small, and so indistinct, that many anatomists have omitted it altogether ; it arises from the upper border of the osseous part of the auditory tube, and descends to be inserted into the manubrium of the malleus, near its short process. *m. Stapedius* is lodged within the tube of the pyramid, from the summit of which a small tendon issues, to be attached to the neck of the stapes.

The labyrinth.—The labyrinth is so called from its complexity ; it lies internal to the tympanum, and consists of three parts ; viz. the vestibule, semicircular canals, and cochlea.

The *vestibule* (plate XXXIII. fig. 1, No. 22 ; plate XXXIV. figs. 2, 3, 4, 5) is a small irregular cavity of an ovoid figure, bounded externally by that bony lamella in which we noticed the fenestra ovalis and promontory, internally by the cribriform lamella at the bottom of the meatus auditorius internus, posteriorly by the semicircular canals, and anteriorly by the cochlea. Along its upper surface runs the aquæductus Fallopii, an osseous tube which leads obliquely outwards and backwards from the meatus internus to the stylo-mastoid foramen, and lodges the facial and vidian nerves. The cavity (plate XXXIV. fig. 5, A) is divided into two slight foveæ, or pits, one being circular, the other oval, and intended to lodge two sacculi, which enclose the expanded part of the auditory nerve. The vestibule is lined by a delicate membrane, which appears to be of the serous class, as it secretes a fine fluid (*liquor Cotunni*) which fills all the intervals left unoccupied by the expansion of the nerve. The following foramina are observable in the interior of the cavity : externally, the fenestra ovalis ; internally, four or five minute holes, which transmit the auditory nerve. These are placed in the plate of bone (*lamina cribrosa*) which closes the meatus auditorius internus ; at its posterior and external part, five openings, which lead into the semicircular canals, two of them opening by a common foramen ; near the common orifice just mentioned is a small foramen (plate XXXIV. fig. 3, No. 8) leading into the aquæductus vestibuli, a small curved canal about four lines long, which leads outwards and backwards to open on the posterior surface of the pars petrosa : it transmits a small vein ; at the anterior and inferior part of the cavity is the opening into the cochlea.

Semicircular canals.—The semicircular canals (plate XXXIII. fig. 1, Nos. 23, 25, 27) are three small osseous tubes (plate XXXIV. figs. 2, 3, 4, 5) curved so as to form a considerable segment of a circle. They are embedded in the substance of the petrous portion of the temporal bone, and therefore cannot be seen until its external plate is removed, and the reticular texture beneath it is pecked away. They are distinguished, by a consideration of their position, into superior or vertical (plate XXXIII. fig. 1, No. 23), external or horizontal (27), and posterior or oblique (25). They lie behind the vestibule, each being somewhat greater than a semicircle. The contiguous limbi of the posterior and superior canals become united for about two lines before they reach the vestibule. Each of the canals is lined by a fine membrane enclosing the expansion of the nerve, and at their vestibular orifice, or commencement, a slight dilatation (24, 26, 28 ; ampulla) will be observed, corresponding with a similar enlargement of the nerve.

Cochlea.—The cochlea (plate XXXIII. fig. 1, Nos. 30, 31, 32 ; plate XXXIV. figs. 2, 3, 4, 5, 6, 7) has been so called from some resemblance to the shell of a snail. When insulated from the rest of

* Figures of these muscles will be found in plate LI. of the division upon the Muscles.

the bone, it is of a pyramidal form, the base being turned to the meatus internus, the apex outwards and a little downwards, so as to approach the horizontal part of the carotid canal. The cochlea consists of a spiral osseous tube coiled round a central axis (plate XXXIV. fig. 6, Nos. 3, 3; *modiolus*). The tube makes two turns and a half from the base of the cochlea to its summit, which is called the *cupola*. From its inner surface projects a thin bony lamella (fig. 6, Nos. 4, 4), which extends about half-way across its cavity, and gives attachment to a delicate membranous plate, which completes the separation of the spiral tube into two parts, called *scalæ*, or stairs. The separation between the *scalæ* is complete in the natural condition, except at the cupola, where the osseous part of the septum is deficient, and allows a communication between them. The septum consists partly of a bony plate, partly of membrane. The former is usually named *lamina spiralis*; it commences at the base of the cochlea, and coils round the modiolus nearly to its apex, where it ends in a hook-like process. The membranous part of the septum is a little broader than the lamina spiralis, from the border of which it extends outwards to the wall of the cochlea, to which it becomes attached, and so completes the partition between the two *scalæ*. One of the *scalæ* (fig. 7, Nos. 5, 5; *scala vestibuli*) commences at the vestibule, and, after making its two turns and a half, ends in the cupola; the other (fig. 7, Nos. 6, 6; *scala tympani*) may be said to commence at the cupola, and, after making its turns round the modiolus, to end at the fenestra rotunda. The base of the *modiolus* communicates with the meatus internus, and is pierced by minute foramina, which give admission to the filaments of the nerve, and to some small blood-vessels: its summit opens into the cupola, where it is expanded, and thence termed *infundibulum*. In the *scala tympani*, near its termination at the fenestra rotunda, a minute foramen exists, which leads into a canal (*aquæductus cochleæ*). This canal is three or four lines long, and terminates at the posterior border of the pars petrosa, near the jugular fossa; it transmits a small vein.

In our description of the nerves and vessels, we must notice the *osseous canals* which lodge or transmit them. The passages which convey the nerves from the cranium to the internal ear are the hiatus Fallopii, the auditory meatus, and the aquæductus Fallopii. The first of these is a fissure which leads obliquely backwards and outwards upon the anterior surface of the pars petrosa of the temporal bone, and which lodges the vidian nerve. The meatus auditorius internus is an oblique canal in the posterior surface of the bone, from two lines and a half to three lines in diameter, and three lines in depth; its direction is outwards and forwards. It is bounded by a concave lamella of bone, and at first appears like a cul-de-sac, but the plate of bone is perforated by foramina. The meatus contains, in the natural condition, the proper auditory and the facial nerve, with a small vessel, a branch of the posterior cerebral artery. In the bottom of the meatus will be observed a slight ridge of bone, which divides it into two pits, the upper or smaller one being for the facial nerve, whilst the lower receives the auditory. A smaller foramen transmits the former, but for the latter there are several; hence the osseous plate is sometimes called lamina cribrosa, from its numerous perforations.

The *auditory nerve*, whilst within the meatus, divides into several filaments, which separately pass through the foramina in its bottom; but they admit of being arranged in three sets, from a consideration of the parts of the labyrinth in which they ultimately terminate. One set passes directly into the base of the cochlea, and is lodged in the hollow of its central pillar or modiolus, from which the nerve proceeds by many minute pores to the *scalæ*, upon the entire surface of which it forms a delicate expansion, supported by the osseous and the membranous part of the septum. The second set of filaments enters the vestibule, and forms an expansion supported by the lining membrane, which is dilated so as to resemble a sac (*sacculus vestibuli*). A third set, situated higher up than the preceding, enters the ampulla at the commencement of the superior semicircular canal. Here it loses its fibrous appearance, as if the nervous matter were formed into a tubular lamella prolonged through the canal, assuming its form, and supported by its lining membrane. Similar nervous expansions exist in the posterior and external semicircular canals.

Membrane of the labyrinth (*labyrinthus membranaceus*).—The interior of the labyrinth is lined by a very delicate membrane, which necessarily takes the form of its different parts and recesses; it gives support to the nerves, and also serves to secrete a limpid fluid (*aqua labyrinthi*), which fills up the intervals left unoccupied by the membrane and the nerves. The fluid is one of the agents employed in conveying impressions from without to the sentient extremities of the auditory nerve. The vibrations of the air, agitated by sounding bodies, act upon the membrana tympani; its various changes necessarily influence the chain of ossicula; so that whatever motion is given to the malleus, is conveyed by it through the incus to the stapes, and so to the membrane of the fenestra ovalis. By

means of the latter, the fluid of the labyrinth is compressed, and through it the nerves; when this is effected, the merely physical part of the function of hearing is completed. But a new chain of phenomena instantly succeeds. The impression received by the nervous expansions in the labyrinth is conveyed to the sensorium, by which means an internal sensation is produced, the character and intensity of the one being proportioned to that of the other. This, which may be considered the second link in the chain, gives still but a simple sensation. Memory and association, in other words previous experience, must lend their aid to enable us to establish that sort of connexion between the mere impressions received and various external agents, which is necessary in order that they should be made to stand in the relation of sign and thing signified.

The *aqueduct of Fallopius* commences at the upper and inner part of the meatus internus; it is a small osseous tube lodged in the pars petrosa, through which it runs from the point just indicated to the stylo-mastoid foramen. At first, for about two lines, it inclines forwards and outwards, then changes, so as to turn outwards and backwards, descending to the foramen above named. It transmits the facial nerve, and also the vidian, which joins the former where the canal changes its direction. In its passage, the nerve gives off some small filaments, which enter the tympanum, and supply its muscles. Mr. Tod observes that the chorda tympani gives branches to all the muscles in the tympanum, and “seems to be the nerve both of motion and perception to these organs.”

The *vessels* of the tympanum, and of the labyrinth.—The stylo-mastoid branch and the ramus tympanicus spread out in minute ramusculi in the tympanum. They are accompanied by veins which take a similar course. The labyrinth is supplied by the internal auditory artery, which enters the meatus internus, together with the nerves, and, after passing through one of the foramina, ramifies upon the lining membrane. The residual blood is returned by two veins, which are lodged in the minute canals called aquæductus vestibuli et cochleæ.

THE NOSE.

Having already described the olfactory nerve and the naso-palatine, it remains to notice the cartilages and the mucous lining membrane.

Cartilages of the Nose (plate XXXV.)—Of these, five are usually enumerated. The *middle* cartilage (fig. 2, No. 2; fig. 4: cartilago septi) is a flat triangular lamella placed vertically; its upper border articulating with the perpendicular plate of the ethmoid bone, the lower resting upon the vomer and maxillary bones, and the anterior supporting the lateral cartilages and the integument. The two *superior lateral* cartilages (fig. 2, Nos. 3, 3) are of a square form, and extend from the nasal bones downwards, between the ascending processes of the superior maxillary bones, with each of which they articulate; and towards the middle line, along the ridge of the nose, they rest against the middle cartilage, which serves to support them. The two *inferior* cartilages (fig. 2, Nos. 4, 4; figs. 5 and 6) form the alæ nasi; they unite superiorly with the preceding, externally with the maxillary bones, and in front with the middle cartilage; they are thin and curved, so as to form the arch of the anterior nares.

The mucous membrane (figs. 8 and 9; *membrana Schneideriana, v. pituitaria*) lines and closely adheres to the bones which form the nasal fossæ—extending from the nostrils, where it is continuous with the skin, to the posterior nares, at which point it joins the mucous membrane of the pharynx. It is also continuous with the lining membrane of the several sinuses which open into the meatus narium, and (through the ductus ad nasum) with the conjunctiva. The pituitary membrane is of a red colour, of considerable thickness, soft, and villous on the surface, except towards the anterior nares, where it becomes thinner and the villi are less numerous. In the situation just mentioned it is studded with strong hairs (fig. 7; *vibrissæ*) which serve to prevent, during inspiration, the entrance of bodies floating in the air.

The membrane that lines the several sinuses differs remarkably from the preceding. It is pale, thin, and adheres very slightly to the surface of the bones.

THE TONGUE.

The *tongue* (plate XXXVI. ; lingua) is not only the proper organ of taste, but, by means of its great mobility, assists other parts in deglutition, in speech, in suction, &c. Its upper surface, or dorsum (fig. 1), is convex in its general outline, and marked along the middle by a slight groove, or raphé (6), which divides it into two symmetrical parts. About a quarter of an inch from its base will be observed a round hole (9; *foramen cæcum*), which forms a sort of reservoir for some of the mucous follicles placed in considerable number in that situation. We speak of its point or anterior nar-

rowed extremity, of its sides, and of its base, which is in intimate connexion with the os hyoides. Upon its upper surface we find several projecting points, or *papillæ*, differing so far in size and number as to admit of being arranged as follows:—1. *Papillæ lenticulares* (8, 8), which vary in number from ten to fifteen, are disposed in two lines, converging to an angle just before the foramen cæcum. They are rounded on their free surface, and resemble so many inverted cones, their summits being embedded in the substance of the tongue. 2. *Papillæ capitatae*, vel *fungiformes* (10, 10), are more numerous than the preceding, and also smaller. They are placed, for the most part, towards the borders and point of the tongue. They present each a rounded head, supported by a short thin pedicle. 3. *Papillæ conicæ*, vel *pyramidales* (11, 11) are much more numerous than the others, and are diffused over the whole of the dorsum of the tongue, from the lenticular papillæ to its point. They are minute and tapering. A fourth class has been recognized by some persons (12, 12; *papillæ filiformes*), but they are very few, and placed close to the apex of the tongue. The papillæ at the point and sides consist of the ultimate terminations of the gustatory nerve, surrounded by a delicate vascular plexus, and supported by cellular tissue.

Structure.—Beneath the mucous membrane is placed a thin but firm lamella of condensed cellular tissue, approaching in its characters to elastic tissue. If all the muscles ordinarily described as belonging to the tongue be dissected away, a considerable mass of fleshy substance will still remain, the fibres of which appear interlaced in such a way as to be with great difficulty traced. Upon the upper surface and sides of the tongue a thin stratum of fleshy fibres is placed, extending longitudinally from behind forwards. At the under surface, the fibres of the linguales muscles run in the same way, but that they form fasciculi, not a layer. If the genio-hyo-glossi be carefully dissected to their insertion, their fibres will be found to turn outwards, or to become blended with others which pass transversely from the raphé to the borders on each side. Both the planes of fibres here noticed are placed horizontally, one being at the upper, the other at the under surface; a third set seems to connect them, by passing vertically from one to the other.

TEGUMENTARY MEMBRANE (EXTERNAL).

The tegumentary membranes, as their name implies (*tegere*, to cover), encase the whole surface of the body, and are also prolonged into its interior, so as to line all those cavities and passages which are in contact with external agencies. This gives rise to a very natural division of them into external and internal, or, in other words, into skin and mucous membrane.

The *skin* (cutis, pellis, common integument, tissu dermoïd,) presents the same form and extent as the body which it covers, and follows all its inequalities, whether they be elevations or depressions. It is a compound structure made up of three layers, viz. corium, rete mucosum, and cuticle.

The Corium.—The *corium* (plate XXXVIII. fig. 3, D, E, F; fig. 4, C, D: cutis vera, δερμα) forms the basis or principal part of the skin; it is much thicker than the others, and gives them support, as it is subjacent to them. By maceration, its tissue becomes softened, and in a manner unravelled; it will then appear to be made up of dense filaments, crossing in various directions so as to enclose spaces or areolæ. These are of considerable size at the inner or attached surface of the membrane, where granules of adeps project into them, but gradually diminish towards the outer surface, where the texture becomes so close and dense as to be considered by some anatomists as a separate layer, which they have named “textus papillaris.” But though there are no adequate grounds for such a subdivision, the term employed expresses a fact which deserves attention, viz. that the surface is not quite smooth or homogeneous, but is studded with a number of minute projections called papillæ.

The corium when examined by itself is pale or dull white, whatever be the tinge which the tegument presents in different races of men or in individuals during life. Any changes of tint which are observed to occur in it, are evidently owing to different degrees of vascularity or of injection, as we see in the state of blushing, and in the rosy hue of health as contrasted with the pallor of disease. Its thickness varies considerably, being in some parts not more than a quarter of a line, in others a line and a half or more. Thus it is very thin in the eyelids, on the mammæ and axillæ; it is thicker at the back part of the trunk than in front, and at the outer than at the inner side of the limbs; and acquires its greatest thickness on the palms of the hands and soles of the feet. As the fluids which it contains evaporate after death, it becomes hard, yellow, and elastic. It is extensible, as we see, when tumours become developed under it, or in pregnancy and hydropic affections; when the distending cause is removed, it slowly retracts. It contains a great quantity of gelatine; on this its capability of being tanned depends; and on its great tenacity its usefulness in the arts when brought to the state of leather.

When proceeding to examine the structure of the corium, a small piece may be detached from some part where it is thick and highly developed; for instance, from the bulb of the thumb, or, still better, from the under surface of the heel. By maceration in water for some while, the cuticle and rete mucosum admit of being easily removed; after which, by immersion in hot water for a few minutes, the papillary projections upon the outer surface are rendered more distinct. The inner surface may, in the next place, be sliced away so as to leave merely the outer stratum rendered so thin as to be translucent. If in this state it be placed under the microscope, its papillary surface will present the appearance indicated in fig. 5, plate XXXVII.; first, a number of minute conical elevations are seen, most of them slightly inclined towards their summits: next, it will be observed, that these are not scattered irregularly; on the contrary, they are disposed in rows or lines (A); as here drawn, the lines appear to be straight, but in their natural position they represent curves in some parts, as on the bulbs of the fingers; they are more or less oblique in others, as on the palm of the hand; or they are transverse, as on the wrist. "These conical papillæ (observes Prochaska) are disposed in curved lines, so that on each line there is a double row of papillæ, between which minute holes are observed, corresponding with the pores visible in the epidermis, through which, when the hand perspires, we can see the drops of sweat to issue." When looking at a piece of corium so prepared, and placed as here indicated, the summits of the papillæ present an appearance not very unlike that given by the summits of bicuspid or molar teeth, as they are passing through the gums in the infantile state.

The papillæ are thus set in raised lines of the corium, separated from one another by linear depressions or furrows. Each raised line, however, is not a continuous ridge: it is intersected from point to point by transverse lines. Now the latter may be called interpapillary, from their being interposed between the papillæ; and the former, interlinear. Each interpapillary furrow will be observed to be slightly depressed at its middle, and at this point there is a minute pore or aperture which gives passage to a sudoriferous duct.

When about to examine the structure of the papillæ, a small slip as thin as it can be taken, may be detached from the edge of a piece of skin, selected as already intimated. A cataract knife will be found useful for such purposes. This slice may be laid on a small piece of glass, and viewed with a single lens, say of the tenth of an inch focus. It will present the appearance indicated in fig. 3, plate XXXVIII. where the papillæ (D, D) are seen in a row, corresponding with the ridge or linear elevation in the corium, already noticed; when examined in this way, they do not all appear of the same size. This may be owing to the displacement of the structure from its natural connexions, or to the want of its usual degree of vascular turgescence; investigations of this kind cannot be conducted without such displacement. Now, in each papilla we can recognise as constituents, 1. the corium raised into a minute summit corresponding with the papilla. 2. Capillary vessels which ramify freely in the corium and around the nerve, but reach no farther than its papillary surface; for if a part, say a finger, be minutely injected, the capillaries will be found to curve, form arches, and return into the veins. 3. The nerves of the skin, when traced in the subcutaneous adipose tissue, present the same characters as elsewhere; but as they enter the corium they gradually become softer and present a waving appearance, and this seems to increase as each filament passes into its papilla. It is difficult to say how it terminates, whether it becomes soft and stripped of its neurilema, or whether it curves and forms a loop; be this as it may, the nerve reaches the summit of the papilla, still without piercing it.

Sudoriferous ducts.—When noticing the appearance of the papillæ and their arrangement, mention was made of the fact, that in each interpapillary furrow a minute pore existed which transmits a sudoriferous duct. These ducts are easily shown by carefully raising and folding back the epidermis of a piece of skin for some time macerated: as it is slowly drawn back, small filaments will be observed along the line of reflection passing from the corium through the rete and epidermis, as represented, fig. 7, plate XXXVII. C, C. These filaments are the ducts; they are tortuous, they admit of being stretched; when torn, they retract instantly, being highly elastic. They pierce the epidermis obliquely, and terminate by open pores upon its surface, as shown, fig. 1, C. As the sudoriferous ducts eliminate from the system an excrementitious fluid,—the perspiration,—it will be asked, how do they commence, or whence do they receive this fluid? Is it from the capillary net-work of the corium? If so, the perspiration must exist already formed in the blood. Analogy with other fluids, such as the bile and urine, would lead us to infer, *à priori*, that the perspiration is elaborated by a distinct apparatus, not of course accumulated into a mass, like the secreting organs of the fluids just mentioned, but diffused in the form of separate particles or granules, and lodged in,

or just under, the tegument. The duct, after piercing the corium, is traced to a small oblong vascular gland-like mass (plate XXXVIII. fig. 3, H, H), which lies embedded in the subcutaneous adipose matter, and which appears to be the immediate secerning organ of the perspired fluid.

Lymphatics.—Besides the blood-vessels, nerves, and sudoriferous ducts, lymphatic vessels exist abundantly on the skin. Whilst injecting the lymphatics of the lower limb with mercury, the fluid, after filling the glands of the groin, will often pass inwards towards the penis and scrotum, creeping for a while under the skin; they then enter its texture, and ramify so freely as to represent a close and intricate net-work. In this way they are injected, contrary to the natural course of the fluids which circulate in them, and consequently in opposition to the valves if there be any. The valves appear to be complete, and to offer resistance to this process in the primary and secondary vessels of this order, but at their peripheral and capillary ramifications the valvular apparatus becomes less and less perfect.

If these vessels be regarded as inhalent or exhalent, how do they commence? Some have said, that they begin with pores, opening on the surface, perhaps from confounding them with the sweat-ducts, or from supposing, according to theoretic views, that there must be openings to admit of the entrance or exit of fluids. The uniform results, however, of injections seem to me to prove that these vessels, like blood-vessels, at their peripheral expansion, which may be regarded as their commencement, form an extensive net-work, and that, whatever passage of fluids takes place into or out of them must be by percolation or imbibition, and not by any capillary movement through pores.

The Rete Mucosum.—The *rete mucosum* (plate XXXVII. figs. 3 and 4; fig. 7, A) appears at first as a glairy exudation between the corium and cuticle, adhering to both, particularly to the former. Malpighi (after whom it has been called *rete Malpighi*; *corpus mucosum*—*rete glutinosum Malpighianum*,) stated it to consist of soft fibres, so arranged as to form a net-work. But Henle has shown that it consists of an assemblage of oval vesicular bodies. It is more and more distinct, in proportion as the skin is of a darker hue, so that it is very easily demonstrated in the dark races. When a blister has been applied to the skin of a negro, if it be not very stimulating, the cuticle alone will be raised in about twelve hours. After this is detached, the exposed surface appears covered with a dark coating. But if the blister has been very active, another layer, of a dark colour, comes away with it. This is the *rete mucosum*, which gives to the different races of mankind their various shades of colour; for the other two layers of the tegument are pale and colourless, as we see when their separation is effected by maceration after death, or by vesicating the living surface.

The nature of the stratum which is thus found interposed between corium and cuticle has given rise to much discussion. Nerves cannot be traced into it, nor has any process of injection shown blood-vessels within it in the healthy state. It appears to be a semi-fluid deposit or secretion, rather than an organised substance: some persons, however, consider it to be a partially organised cellular tissue, containing in its areolæ a dark substance resembling the pigmentum nigrum of the eye; others, as Gautier and Dutrochet, go so far as to resolve it into four layers placed one over the other. In the white races the rete not only loses all colour, but becomes so thin, that it is difficult to demonstrate it; indeed, some eminent anatomists, Bichât, Chaussier, and Dr. Gordon, from these circumstances, denied its existence altogether. But we generally find, on attentive examination, a viscid, semi-fluid stratum occupying the situation of the rete, which, however, is soft and glairy, and, most probably, a secretion produced by the vascular surface of the cutis, or by a special apparatus.

M. Breschet is disposed from various considerations to take the rete and the cuticle together, and to regard them as strata of corneous structure deposited upon the corium. “Nous considérons ici comme épiderme toute l'épaisseur de la couche cornée qui est située au dessus du derme, et qui est traversée par plusieurs organes. Le feuillet le plus externe de cette substance cornée constitue la cuticule ou l'épiderme proprement dit de beaucoup d'auteurs.” [Recherches sur la structure de la peau, p. 38, note.] We still, however, shall continue to consider these two lamellæ as sufficiently distinct to retain them as separate structures and to treat of each separately. Though the rete possesses neither nerves nor blood-vessels, (we have already stated that both these reach no farther than the papillary surface of the corium,) still vessels of another kind are recognised by M. Breschet himself as existing in it, and which he considers to be analogous to lymphatics, and to constitute an inhalent apparatus. Now, as nothing of this kind exists in the epidermis, we may consider this circumstance, together with its scale-like texture and difference of colour, sufficient to distinguish it from the rete.

When a piece of skin has been sufficiently macerated to allow the cuticle and rete to be detached

(having selected a part where the cuticle is thickened), we can readily see the rete as a distinct layer, particularly if the piece so prepared be placed in spirit, so as to corrugate it a little. The rete, soft and thin, appears as if it had been moulded upon the corium; it takes an exact impression of its lines and ridges and papillæ, as represented in fig. 3. Now when in raising the rete and epidermis, in order to see the sweat-ducts, as shown in fig. 7, we can with the aid of a glass recognise other tubes which are distinguished from the ducts by their smaller size, by anastomosing with one another, so as to form a net-work (which the ducts never do). Moreover, they are not tortuous, nor do they pierce the epidermis. Some offsets or efferent vessels issue from this net-work, and pierce the corium close to the pore which transmits the sweat-duct, and appear to terminate in the venous capillaries of the corium. Within the meshes thus formed is deposited that soft, glairy, mucus-like deposit which gives to the tegument its different shades of colour. Is this product exuded by the vessels here noticed, or by the capillary vessels of the corium; or is it secreted by a distinct apparatus? M. Breschet describes and delineates two distinct secreting organs, one for the mucus which he terms blennogenous (*βλέννα* mucus, *γενναω* I produce), and the other, for the colour, chromatogenous (*χρῶμα* colour, *γενναω*). Those which produce the mucus he describes as minute red glands (*petites glandes rougeâtres*) placed just under the corium, embedded amongst adipose vesicles. From the summit of each a duct issues which pierces the corium and opens upon its surface. The colour-producing apparatus Breschet places towards the outer surface of the corium beneath and between the papillary ridges, and in the depth of the interlinear furrows. The secreted product is poured into the grooves by minute ducts.

The Cuticle.—The *cuticle* (plate XXXVII. fig. 1 and 2; plate XXXVIII. figs. 3, A; fig. 4, A; cuticula, epidermis, scarf-skin) is the outer layer of the tegument. Though very thin in most parts, it becomes thick and indurated in the soles of the feet, or wherever it is habitually subjected to pressure. Its inner surface is connected with the rete mucosum and corium by delicate filaments and by the sweat-ducts, but can be readily separated from them by decoction or maceration: the external surface presents a number of narrow lines or ridges, which make it appear, when examined with a glass, rugged and uneven. This observation seems to have led to an opinion entertained by some anatomists, namely, that the cuticle consists of scales, or lamellæ, disposed like those of fishes, or imbricated. The raised lines here noticed (plate XXXVII. fig. 1, A; plate XXXVIII. fig. 3), correspond with those of the corium; their direction varies, being more or less curved, oblique, or transverse, as may at once be seen by viewing them with a lens upon the ends of the fingers, the palm of the hand, and then at the wrist. These lines are separated by furrows, which are depressed into those of the corium, the rete interposing. These interlinear furrows are intersected by transverse ones, in the middle of each of which we can readily see with the aid of a glass, and often with the unassisted eye, a minute porous depression or infundibulum (plate XXXVII. fig. 1, C), where the sweat-duct terminates. As the epidermis is very thin, its inner surface presents, when raised from its connexions, the reverse of these elevations and depressions (fig. 2). This view of it shows that it is so deposited upon the papillary surface of the corium, as to form a mould representing all its elevations and depressions. This is seen more distinctly if the epidermis be slightly corrugated by immersion in spirit or solution of alum. When first exuded, it resembles a thin pellicle of mucus laid upon the surface; and, if examined beneath the microscope, it will be observed to consist of an assemblage of minute oval vesicles like those of the rete mucosum. As it gradually dries and loses its semi-fluid appearance, the vesicles become flattened in oval scales, having a nucleus in the centre of each, and the lines and ridges become apparent. We can easily trace the steps of these changes, if we note what takes place when it is reproduced upon a part that has been blistered. When the cuticle is detached and laid in water, for some while its inner surface appears smooth and uniform. This is owing to its being stretched by the process to which it is subjected. Moreover, even the pores through which the sweat-ducts pass are invisible; hence many anatomists have denied their existence. Béclard says that he charged a shred of epidermis with a column of mercury, about the weight of one atmosphere, and yet could not perceive any proof of its being porous. This is explicable by reference to a fact above stated with regard to the sweat-ducts, viz. that they are so elastic, that when stretched they retract forcibly, and contract their calibre so as effectually to close the porosities. As the epidermis is insensible, and without vessels or nerves, we may liken it to a dry varnish, which protects the sentient surface of the corium from irritation; moreover, it lessens evaporation, and impedes if it does not altogether resist the absorption of injurious substances.

The Hairs.—To the skin are attached, as appendages, the hairs and nails.

Hairs (plate XXXVIII. fig. 4, K; crines, pili) are slender, conical, horny filaments, which in many animals cover nearly the whole body; but in man are principally developed upon the scalp, pubes, and chin. Each hair consists of a stem and a root. The former is free and unattached, of a different colour in different individuals, and tapering towards its summit, which is usually split, or subdivided into filaments; the root is destitute of colour, and bulbous or irregular in its form. If a hair be plucked out, the part which had been lodged in the skin is found covered by a thin white tubular sheath which still adheres to it. If examined with a glass whilst still in its place, the stem of the hair being at the same time drawn tightly, as if in the act of plucking it out, the sheath here noticed appears at its outer edge to be continuous with the corium at the point where the hair pierces it. By dividing this tube, and drawing it aside with the point of a fine needle, another membrane, softer and thinner, appears within it, and which seems connected with the rete mucosum. In treating of this subject, we constantly employ the terms "bulb, follicle, papilla." Sometimes the word bulb is used as if it were meant to express the widened and colourless part of the hair, together with its membranous sheath, as they are seen when extracted; this obviously includes two things which are sufficiently distinct. Bécclard (*Anat. Gen.* v. 336) takes bulb and follicle as synonymous terms; he says, "The bulb or follicle of the hairs, which Malpighi compared to the vessels in which gardeners plant flowers, is situated in the substance of the dermis, or beneath it." It seems to me better to restrict the word bulb to the root or point of origin of the hair, where it is colourless, soft, and a little enlarged; follicle will then properly express the tubular canal in which it is lodged whilst within the corium. The follicle is supplied with some minute capillary vessels, and also nervous filaments. Bécclard, following out his general views as to the continuity of tissues, views the matter in this way. The outer layer of the sheath is traced down from the corium, the other from the rete; both rise a little at the bottom of the tube to form a secreting papilla: as to the cuticle, it is obviously reflected outwards upon the stem of the hair, and becomes united with its outer surface. The bulbs of the hairs, therefore, observes Bécclard, "seem to consist of a small part of the skin, sunk, depressed, or folded upon itself, surmounted by a papilla, which is supplied with vessels and nerves." The analogy between hairs and nails, and a consideration of the mode of implantation and growth of the latter, support this view of the subject. M. Breschet (*Recherches sur les appareils tegumentaires*, p. 84) observes that he has not as yet determined (the subject being still under examination) whether the hairs arise, as they are commonly said to do, in a duplicature of the skin, or whether they are secreted by glandular organs placed at the inner surface of the corium (*à la base du derm*). He inclines to the latter opinion. If it be established, then, we shall have to modify our view of the matter slightly, and the facts will stand thus:—The bulb of the hair is implanted on the papilla, which secretes it in the first instance, and supplies materials for its growth, which are added continually to its base, so as to elongate it and cause its protrusion. The papilla at its base is connected with the surrounding cellular tissue by filaments, and by nerves and vessels; whilst by its summit and sides it gives attachment to the bulb of the hair. The investing sheath, already noticed, continuous with the corium and rete at the point of emergence of the hair, dips down, enclosing it as far as its edge, where it is slightly connected with the papilla. But these are not the only means by which it is fixed in its situation: the cuticle dips into the orifice of the follicle for a little way, and so comes into contact with the surface of the hair, on which it is reflected and prolonged, so as to become in a manner identified with its structure.

The difference of colour in hair seems to depend, according to Vauquelin, on the presence or absence of a coloured oil. He found in black hair a substance resembling mucus, and which appears to be a modified albumen, with two oily matters, one colourless, the other a greenish black tinge, and rather thick. He obtained also in his analysis phosphate and carbonate of lime, oxide of manganese and iron, sulphur and some silex. In red hair the iron and manganese exist in less quantity, and the coloured oil is of a reddish tinge. In fair hair the coloured oil is less; in that which is perfectly white it is altogether colourless. The saline substance appears to be that which imparts the colour to the animal matter or oil: we know that hair admits readily of being dyed whilst still growing, or after it is cut off.

The Nails.—The *nails* (plate XXXVIII. figs. 6, 7, 8; ungues) are horny lamellæ, or scales, placed at the extremities of the fingers and toes, on their dorsal surface. The root of the nail (fig. 8, A), which is about one-fifth of its length, is thin and white, dentated at its margin, and received into a groove, or sulcus (fig. 6, B), in the corium; its external surface is convex, and marked by some slight longitudinal lines running from behind forwards. At the posterior

or attached extremity, a small portion will be observed, differing in colour from the rest, and usually called "lunula" (fig. 8, B), from its form: the free extremity of a nail is its thickest part, and projects for some way beyond the end of the finger. The mode of connexion established between the nail and the tegument is as follows:—The subjacent part of the corium, thick and red, is surmounted by a number of papillæ (fig. 7, C), placed in linear series on every part of it, except that beneath the lunula. The under surface of the nail is at the same time soft, and marked by narrow grooves (fig. 8, C), intended to lodge the papillæ just noticed, and to become intimately connected with them: again, its posterior extremity is received into a sulcus in the corium, which at this point is stripped of its epidermis; but the latter, at the root of the nail, dips into the sulcus and becomes reflected on its upper surface, forming a smooth, superficial lamella upon it. At the free extremity of the nail, the epidermis, after covering the end of the finger, is reflected on its under surface, becoming identified with it. Finally, the disposition of the epidermis along the sides resembles, for a short way, that which takes place at the root; but further forwards it is reflected in the way that obtains at the free border of the nail.

In fig. 6, by a vertical section of the last phalanx of the thumb, the relation of the cuticle and corium to the nail, and of the latter to the papillæ, is shown. At fig. 9, an enlarged view of the papillæ is given, and of the loops formed by the vessels within them.

Hairs and nails, with the analogous textures, feathers, wool, claws, and hoofs, in different animals, form a section by themselves under the head Corneous, or Horny tissue. They grow and increase by deposits at their base of a glairy fluid or semi-fluid matter, resembling mucus or modified albumen, which gradually concretes and becomes harder as it is pushed forward and protruded.

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